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ON THE EXTINCT CATS OF AMERICA.

BY E. D. COPE.

IN following the general series of the *Carnivora*, we pass, as in other orders, from the generalized to the specialized types. That we should begin with the *Procyonidæ* (raccoons) and their allies, is indicated by all the characters to be especially considered in the case. They have five toes on all the feet and are plantigrade, resembling in these points all primitive *Mammalia*.[1] They have the original number of molar teeth, seven on each side, and of these none are distinctly developed sectorials. The condyloid and carotid foramina are distinct, and there is a postglenoid foramen. If, starting from this point of departure, we arrange the succeeding families of *Carnivora* according to their resemblances and differences in these respects, we have a tolerably consecutive series of divisions.

Passing at present over the families *Mustelidæ*, *Viverridæ*, *Cryptoproctidæ* and others, with five toes on all the feet, we reach those in which the hind foot has lost a digit, leaving the number 5—4. These are the *Protelidæ*, *Canidæ* and *Felidæ*. We can take but one step further in this order, that is, to those species where the anterior foot has also lost a toe, which constitute the family *Hyænidæ*. The toes are therefore here 4—4. For the well-marked characters of the three families mentioned just before, I refer to another page, and proceed to define, briefly, the division which has been heretofore termed the *Felidæ*. In doing so I am compelled to omit several of the characters generally employed

[1] See Homologies and Origin of Types of Molar Teeth of *Mammalia educabilia*. Journal Academy Phila., 1874, March.

to define that family, since I have found them to be wanting from various extinct genera. The only comprehensive definition which I can give is the following:

Digits 5—4. Sectorial teeth well developed in both jaws; not more than one true molar tooth in the upper, nor more than two true molar teeth in the lower jaw. Glenoid cavity grasping mandibular condyle anteriorly as well as posteriorly.

Prof. Gill, who has devoted much attention to the definition of the families of the *Mammalia*,[1] gives the following skeletal characters in his diagnoses of the *Felidæ* and of the three comprehensive divisions within which he places it. "I. Skull with the paroccipital process applied closely to the auditory bulla; the mastoid process small or obsolete; external auditory meatus very short or imperfect. Div. A. Carotid canal minute and superficial or obsolete; condyloid foramen and foramen lacerumposticum debouching into a common fossa; glenoid foramen minute or null. Os peuis rudimentary. Subdiv. 1. Otic bulla divided by a septum into posterior and anterior chambers communicating by a narrow aperture (Flower). Subdiv. a. Skull with no alisphenoid canal." All of the parts here mentioned I have found to be important in the definition of the natural divisions of the *Carnivora*, excepting those derived from the paroccipital and mastoid processes. But their condition in the extinct *Carnivora* which have been hitherto arranged with the *Felidæ*, and which resemble them very much in superficial characters, does not coincide with Prof. Gill's definition. Thus in the various American genera which resemble *Drepanodon*, the carotid canal is distinct from the *foramen lacerum posterius*, and the condyloid foramen is also separated from it by quite a space. These are characters which belong to most of the *Carnivora* with five digits on all the feet. Further, the postglenoid and postparietal foramina are present, also characters of the lowest *Carnivora*, as the bears and certain extinct dogs. Then there is an alisphenoid canal, which is also found in bears, dogs and the cat-like *Cryptoprocta*. I cannot demonstrate that the otic bulla is divided as the above diagnosis requires, in any of the fossil species. I have verified the above characters on species of the following genera, of which I have well preserved skulls; *Archælurus*, *Nimravus*, *Dinictis*, *Pogonodon*,[2]

[1] Arrangement of the Families of Mammals. Smithson. Miscell. Coll., 230, 1872, p. 56.

[2] Except those of the base of the skull.

and *Hoplophoneus*. Three genera, as yet only found in Europe, are similar in general characters, and probably agree with them. I allude to *Proœlurus* Filh., *Ælurogale* Filh., and *Eusmilus* Gerv. On the other hand, the genus *Smilodon*, which includes the American sabre-tooths of Pliocene age, agrees with the true cats in the points in question; *i. e.*, the alisphenoid, postglenoid and postparietal foramina are wanting; the carotid foramen is either internal or wanting, and the condylar enters the jugular foramen at its mouth. This surprising condition of affairs makes it important to learn the characters to be found in the species of the longest known genus, *Drepanodon*, of the European beds. But although there are several good crania in European museums, I can find no description of their minute characters, and no mention made of their foramina. The probabilities are, on various grounds, that this genus agrees with *Smilodon* in the latter characters. The reasons in favor of this supposition are, the agreement in special dental characters, and the Pliocene age of the typical species, *D. cultridens*. Whether the Miocene species of Sansan and Epplesheim agree with this one in structure, is of course uncertain.

Seven and perhaps eight genera then, constitute a group to be distinguished from the true *Felidæ*, and, as it appears to me, as a distinct family. Should we ignore the characters adduced in this instance, we abandon at the same time the definitions of several of the other families of the order, and in fact, throw the system into confusion. I have proposed to call this family the *Nimravidæ*, and have contrasted it with the *Felidæ* in the following definition. Both are included n the division already defined on a preceding page.

No distinct carotid foramen nor alisphenoid canal; condylar foramen entering the foramen lacerum posterius. No postparietal, and generally no post glenoid foramina; *Felidæ*.

Carotid and condylar foramina entirely distinct from the foramen lacerum posterius; an alisphenoid canal, and post glenoid and postparietal foramina; *Nimravidæ*.

NIMRAVIDÆ.

The dental characters of the *Nimravidæ* are in general those of the *Felidæ*, the higher genera having the same dental formula.

Descending the scale the number of molar teeth increases at both ends of the series in the lower jaw, and anteriorly only in the upper, the number of the true molars never exceeding $\frac{1}{2}$. The following table gives the definitions of the genera. I am unfortunately ignorant of the characters of the foramina in *Prœlurus* and *Pseudælurus*, as well as in *Ælurogale* and *Eusmilus*.

I. Lateral and anterior faces of mandible continuous; no inferior flange.

a. No anterior basal lobe of superior sectorial; inferior sectorial with a heel; canines smooth.

Molars $\frac{4}{4}$ $\frac{1}{2}$; inferior sectorial with interior tubercle.....*Prœlurus*.
Molars $\frac{3}{3}$ $\frac{1}{1}$; inferior sectorial without interior tubercle.....*Pseudælurus*.

II. Lateral and anterior faces of mandibles separated by a vertical angle; no inferior flange; incisors obspatulate.

a. No anterior basal lobe of superior sectorial; inferior sectorial with a heel (and no internal tubercle); incisors truncate.

Molars $\frac{4}{4}$ $\frac{1}{2}$; canine smooth.....*Archælurus*.
Molars $\frac{3}{3}$ $\frac{1}{2}$; canine denticulate.....*Ælurogale*.
Molars $\frac{3}{2}$ $\frac{1}{2}$; canine denticulate.....*Nimravus*.

III. Lateral and anterior faces of mandible separated by a vertical angle; an inferior flange; incisors conic, canines denticulate.[1]

a. No or a small anterior basal lobe of superior sectorial;[2] inferior sectorial with a heel. No posterior lobes of the crowns of the premolars.

Molars $\frac{3}{3}$ $\frac{1}{2}$.....*Dinictis*.
Molars $\frac{3}{3}$ $\frac{1}{1}$.....*Pogonodon*.
Molars $\frac{2-3}{2}$ $\frac{1}{1}$.....*Hoplophoneus*.
Molars $\frac{?}{1}$ $\frac{?}{1}$.....*Eusmilus*.

It is readily perceived that the genera above enumerated form an unusually simple series, representing stages in the following modifications of parts: (1) In the reduced number of molar teeth. (2) In the enlarged size of the superior canine teeth. (3) In the diminished size of the inferior canine teeth. (4) In the conic form of the crowns of the incisors. (5) In the addition of a cutting lobe to the anterior base of the superior sectorial tooth. (6) In the obliteration of the inner tubercle of the lower sectorial; and (7) in the extinction of the heel of the same. (8) In the development of an inferior flange and lateroanterior angle of the

[1] Gervais' figures of the canines of *Eusmilus bidentatus* represent no denticulations, but the figure is not clear.

[2] Rudimental in *Hoplophoneus*.

front of the ramus of the lower jaw. (9) In the development of cutting lobes on the posterior borders of the larger premolar teeth.

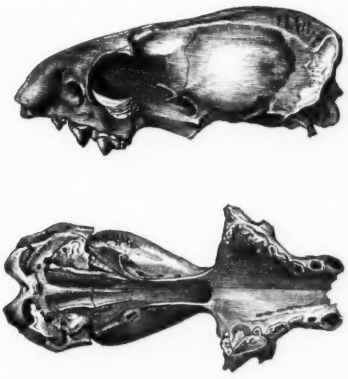


FIG. 1.—*Proælurus julieni* Filh.; two-thirds nat. size. From Filhol.

(1) The reduction in the number of molar teeth. The dental formula of *Proælurus* is that of some *Viverridæ* and *Canidæ*, and the reduction from this point to the end of the series is obvious. In *Eusmilus*, as in *Smilodon*, the number of molars is less by one in the inferior series, than in *Lynx* and *Neofelis*, where the formula is the smallest known among *Felidæ* proper, viz: $\frac{2}{2}\ \frac{1}{1}$. (2) The enlarged size of the superior canine teeth. In *Proælurus* and *Pseudælurus*, the canines of both jaws are subequally developed as in recent *Felidæ*. In *Archælurus* the superior is the larger, but does not, relatively to the molars, exceed that of *Felis*. It is rather compressed in form, and has a sharp cutting edge posteriorly. In *Nimravus* the superior canine begins to have the enlarged size of the sabre-tooths, but its form is peculiar in the *N. gomphodus*, being spike-shaped rather than sabre-shaped. We find the true sabre-shape first in *Dinictis*, where it is compressed, and with a denticulate cutting edge on both front and rear. In *Pogonodon* it has reached a very large size, and it does not display much increase in this respect until we reach the last genus of the series,

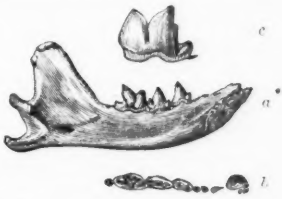


FIG. 2.—*Proælurus julieni* Filh.; two-thirds nat. size; *a* inner view of mandible; *b* superior view of inferior teeth; *c* inferior sectorial, natural size. From Filhol.

Eusmilus, where its proportions are enormous; almost as large as in the feline genus *Smilodon*, where they appear to have been an inconvenience to the animal. (3) The diminished size of the inferior canines becomes evident in the lower genera of the third division (supra) of the *Nimravidæ*, but is most decided in the highest genera *Hoplophoneus* and *Eusmilus*. (4) The incisor teeth have the usual obspatulate or obovate outline in the genera of the first and second divisions of the family, including *Nimravus*. They are conic in the true sabre-tooths with flared lower jaw, beginning with *Dinictis* and ending with *Eusmilus*. (5, 6 and 7) The structure of the sectorials. The presence of a heel and an inner tubercle of the lower sectorial are well known characters of a majority of the *Carnivora*. In only the most highly organized genera are they wanting, and among them are included all those of the *Felidæ* that still exist. In the *Nimravidæ* the inferior genera have both in a reduced degree, and they soon disappear as we ascend the scale. Thus the inner tubercle is only present in the species of *Proælurus*, *Dinictis* and *Hoplophoneus*. The heel on the other hand remains throughout the entire family. The anterior basal lobe of the superior sectorial has the same history, its absence being characteristic of the inferior *Carnivora*, and of all the genera of *Nimravidæ*, except in *Hoplophoneus*, where it is rudimental. It is well developed in *Drepanodon*, as in recent *Felidæ*, and is double in *Smilodon neogæus*. (8) The development of the inferior flange and lateroanterior angle of the mandibular ramus. There is a successive advance in the development of these characters, beginning with the second group, for in the first they are wanting. The lateroanterior angle is developed in *Archælurus* and allied genera, and is merely continued on the inferior border of the ramus. In the third group it is much more acute, and is deflected downwards, forming the well known flange of the sabre-tooths. It is longest in the *Eusmilus bidentatus* Filh. (9) The highest genera of *Nimravidæ*, e. g. *Hoplophoneus*, differ from the true *Felidæ*, in the absence of the cutting lobes on the posterior edges of the crowns of the larger premolar teeth. But according to Filhol these lobes are present in the generalized genera, *Proælurus* and *Pseudælurus*, which are thus brought into a relation with the *Felidæ*, not possessed by other *Nimravidæ*.

A characteristic perfection of the *Felidæ* is seen in the genus *Smilodon*; that is, the vertical direction of the ungual phalanges, by

which the claws become retractile. This is well displayed by the two splendid specimens of *Smilodon necator* from Buenos Ayres, which have been preserved (See Fig. 12). Unfortunately, these phalanges have not yet been discovered in any species or the *Nimravidæ*, and it is not yet certain what their structure really was. Among the true *Felidæ*, the genus *Cynælurus* displays a less degree of development in this respect than the other genera, the ungual phalanges lacking the proximal process below the articular facet. Such a condition is to be looked for among the less perfect genera of *Nimravidæ*.

The succession of genera above pointed out coincides with the order of geologic time very nearly. Those belonging to groups first and second, belong to the lower and middle Miocene, except *Ælurogale*, which is perhaps upper Eocene, and *Pseudælurus*, which is middle Miocene. The genera of the first group of division third, have the same lower Miocene age, except *Eusmilus*, which has been found in the same formation (Phosphorites) as the *Ælurogale*.

The relations of these genera are very close, as they differ in many cases by the addition or subtraction of a single tooth from each dental series. These characters are not even always constant in the same species, so that the evidence of descent, so far as the genera are concerned, is conclusive. No fuller genealogical series exists than that which I have discovered among the extinct cats.

As to the phylogeny of this family, there are flesh-eaters of the Eocene period which may well have been the ancestors of both the *Nimravidæ* and *Felidæ*.[1] I have suggested that this position is most appropriately held by the *Oxyænidæ*, a family of several genera, which included the most formidable rapacious mammals of that early period in both continents. The interval between them and the *Nimravidæ* is however great, for in the *Oxyænidæ* when there is a sectorial tooth of the upper jaw, the first true molar is utilized instead of the last premolar; and the second true molar below is a sectorial as well as the first. Several intervening forms must yet be found to complete the connection, if it have ever existed. It is, however, very likely that the true *Felidæ* were derived from the genus *Proælurus* through *Pseudælurus*, if indeed these two genera be not the primitive members of that family, for as above

[1] See, On the genera of the *Creodonta*, by E. D. Cope, Proceed. Amer. Philos. Soc. July, 1880.

remarked, the evidence of their possession of the characters of the *Nimravidæ* has not yet been obtained. There can be no reasonable doubt that the genera *Drepanodon* and *Smilodon* in the *Felidæ* are the descendants of *Hoplophoneus* and allied genera. In fact, the *Nimravidæ* and *Felidæ* are "homologous groups," having corresponding terms in the manner I foreshadowed as a general principle in 1868 (Origin of Genera).

In looking for causes in explanation of the modifications of structure cited, one can easily discover that there is a close relation between the arrangement of the teeth and the mechanical laws involved in the performance of their function, those of seizing an active prey, and of cutting up their carcasses into pieces suitable for swallowing. It is obvious that in the latter case the flesh teeth bear the resistance, and the masseter muscle is the power, and that the nearer these parts are together, the better is the function performed. As a matter of fact, the sectorial teeth in modern carnivora are placed exactly at the angle of the mouth, which is the front border of the masseter muscle.

In the process of evolution both the muscle and the teeth have moved forwards in connection with the shortening of the jaw behind. This has been due to the necessity of bringing the power (masseter) nearer to another point of resistance, viz: the canine teeth.

In the early carnivores (as Hyænodontidæ) the long jaws supported more numerous teeth ($\frac{4-3}{4-3}$) than in any modern families, and the fissure of the mouth was probably very wide, as the last molar was a sectorial. The canine teeth were evidently very ineffective weapons. The animals probably only snapped with their jaws, and did not attempt to lacerate or hold on, as do the cats.

The dogs of to-day are long jawed, and they snap in a manner quite distinct from anything seen among the cats. The only dogs that hold on are the short jawed bull-dogs.

So in the use of the canines we have the ground of the shortening of the jaw behind and before, and the consequent change of structure which resulted in the modern perfected *Felidæ*.[1]

The following list shows the number and distribution of the species of the *Nimravidæ*:

[1] See AMERICAN NATURALIST, 1878, p. 171.

	Upper Eocene.	Lower Miocene.		Upper Miocene.		Pliocene.	
	Eur.	Eur.	Am.	Eur.	Am.	Asia. Eur.	Am.
Proælurus julieni Filh		×					
" lemanensis Filh.		×					
Pseudælurus hyænoides Blv.				×			
" edvardsi Filh.	×						
" intrepidus Leidy.					×		
" sivalensis Lydd.						×	
Archælurus debilis Cope			×				
Ælurogale intermedia Filh.	×						
" "acutata Filh."[1]							
Nimravus gomphodus Cope.			×				
" confertus Cope			×				
Dinictis felina Leidy			×				
" cyclops Cope			×				
" squalidens Cope			×				
Pogonodon platycopis Cope			×				
" brachyops Cope			×				
Hoplophoneus oreodontis Cope			×				
" primævus Leidy			×				
" occidentalis Leidy			×				
" cerebralis Cope			×				
Eusmilus bidentatus Filh.	×						

We may now consider in more detail the characters of the genera and species of North America.

Division I. The Primitive Cats.

PSEUDÆLURUS Gervais. Although this genus commences in the Phosphorites of France, which are generally referred to the upper Eocene, it has at least some dental characters of the true *Felidæ*. Even at that early period, if well defined period, it be,[2] the premolar teeth are lobed; see *P. edvardsi* Filhol. The single American species, the *P. intrepidus* Leidy is from a late Miocene formation, the Loup Fork. It is only known from lower jaws, of which Dr. Hayden procured one in Nebraska, and the writer another in Colorado. It was a species with large teeth, of about the size of the Canada lynx.

Division II. The False Sabre-tooths.

ARCHÆLURUS Cope.

This genus is of interest as completing the connection between the sabre-tooth and primitive unspecialized groups of the cats, a transition also clearly indicated by the genus *Nimravus*. In den-

[1] I only know this species by name.

[2] The Phosphorites are suspected by some to contain mixed materials from different horizons.

tition it adds a tooth to the number belonging to that genus, in both jaws, and has a smooth-edged canine; it is otherwise identical with that genus, unless, indeed, the exostosis supporting the inferior sectorial tooth in the *A. debilis*, be introduced into this category; a position I am not prepared to assume positively. There is but one species known, the

Archælurus debilis Cope.

It is probable that this was an animal presenting much the appearance of the existing cats, and of about the size of the American panther. Omitting more technical characters, it differed from this and other species of the *Felidæ* in the greater slenderness of its feet. Its head was characterized by less breadth through the posterior part of the cheeks, and by a greater convexity of the forehead between the eyes, and a greater prolongation backwards of the same region.

Its structure plainly indicates that this species was of less sanguinary habits than the existing *Felidæ*, since its prehensile organs, both of the feet and dentition, are less robust. The slender zygomata and rami of the lower jaw show also that the impact of its bite was less powerful, although the large size and narrow form of the sectorial teeth, furnish an effective cutting apparatus, which in some degree supplements the deficiency of strength. The weakness of the rami is further provided against

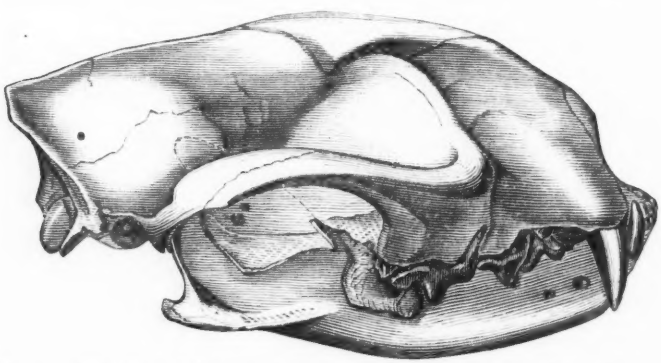


FIG. 3.—*Archælurus debilis*, one-half natural size. Mus. Cope. From Vol. IV, Report of U. S. Geol. Surv. Terrs.

by the curious exostosis at the base of the inferior sectorial, already mentioned; see Fig. 3.

The first description of this species was given by myself under the head of the *Nimravus brachyops* (*Machærodus brachyops*. Palæontol. Bulletin, 30, p. 10, Dec., 1878), from a skull found by

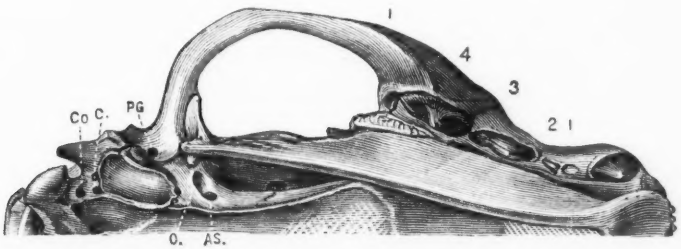


FIG. 4.—*Archælurus debilis*, one-half nat. size; inferior aspect of Fig. 1. Foramina: AS, alisphenoid; O, ovale; PG, postglenoid; C, carotid; Co, condylar.

Mr. Sternberg, under the impression that it might belong to a female of that species. Subsequently a nearly perfect cranium, obtained by Mr. Wortman, demonstrated the distinctness of the animal both as to species and genus.

Horizon and Locality. The remains of the *Archælurus debilis* have so far been only found in the Truckee Miocene formation of the John Day river, Central Oregon. Judging from the remains, it was, after the *Nimravus gomphodus* the most abundant feline of that region.

NIMRAVUS Cope.

This genus has the dental formula and characters of *Hoplophoneus*, with the addition of a tubercular inferior molar tooth. It is, moreover, not a true sabre-tooth, as is that genus, since it does not display the inferior anterior flange of the mandible. This is represented by an obtuse angular border, quite as in the species of *Archælurus*, in which genus *Nimravus* finds its nearest ally. The constant absence of the anterior premolars in both jaws distinguishes it sufficiently from that genus. On this account, and in view of the larger development and denticulated edge of the superior canine teeth, *Nimravus* may be considered as occupying a position between the two genera above named.

Two species are known to me, a larger and a smaller, both from the Middle Miocene formation.

Nimravus gomphodus Cope.

The *Nimravus gomphodus* is as large as the full-grown panther of the large varieties. It probably stood as high above the ground, but whether the body had the elongate proportions of that animal, or the more robust form of the leopard and jaguar, cannot be ascertained in the absence of necessary material. Unless the animal had pendulous upper lips, a thing unknown among cats, the superior canine teeth must have been distinctly displayed on each side of the chin; their points descending entirely below the lower margin of the lower jaw, when the mouth is closed. As these points are less compressed than in the true sabre-tooths, they were less liable to fracture from lateral blows, but were more apt to be broken by fore-and-aft strains, owing to their slenderness.

FIG. 6. FIG. 5.

FIG. 5.—End of tibia and astragalus of *Archælurus debilis*. FIG. 6.—Femur of *Nimravus gomphodus*. All one-third natural size. Mus. Cope.

The long canines of this species testify to blood-thirsty habits, for as weapons for penetrating wounds they are without rival among carnivorous animals. They resemble considerably the teeth of some of the *Dinosauria*, for instance, those of the Triassic *Clepsysaurus*. The sectorial apparatus is especially effective, and no tissue could long resist the combined action of the opposing blades of the two jaws. Nevertheless this species did not, probably, attack the large *Merycochœri* of the Oregon herbivores, for their superior size and powerful tusks would generally enable them to resist an enemy of the size of this species. They were left for the two species of *Pogonodon*, who doubtless held the field in Oregon against all rivals. The compressed mandibular rami of the *Nimravus gomphodus*, though less slender than those of the *Archælurus debilis*, are not so well calculated to resist lateral strains as the more robust jaws of the majority of the existing *Felidæ*.

Nimravus confertus Cope.

Although a left mandibular ramus is all that I have been able to obtain of this cat, the evidence is sufficient that it is specifi-

cally different from the others enumerated in this chapter. It is inferior in size, and peculiar in the reduced symphyseal and in-

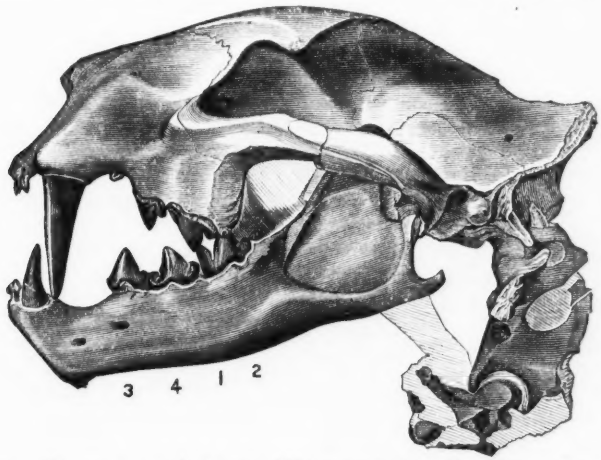


Fig. 7.—*Nimravus gomphodus*, two-fifths natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

cisive parts of the mandible. It was found by Mr. Wortman in the bad-lands of the John Day valley, Oregon.

Division III. The Primitive Sabre-tooths.

DINICTIS Leidy.

With this genus we enter the group of the primitive sabre-tooths, commencing with the most generalized form. The skeleton is yet unknown, but the skull and dentition are those of a true sabre-tooth, and there seems to be no ground for believing the Musteline affinities suggested by Leidy.[1] It occupies the lowest position on the line of the sabre-tooths, on account of its numerous and simply constructed molar teeth, and stands in immediate connection with the false sabre-tooth group, having exactly the dental formula of *Ælurogale* Filh. On this account I formerly united the two genera, but now believe that the absence of the inferior flange of the mandible in *Ælurogale* is sufficient ground for maintaining them as distinct. The latter genus, in this respect, exactly resembles *Archælurus* and *Nimravus*.

Remains of this genus are quite abundant in the White River

[1] Extinct Mammalia, Dak., Nebr., p. 64.

formation in Nebraska and Colorado. They principally belong to the longest known and typical species, *D. felina* Leidy. Specimens are much less numerous in the Truckee beds of Oregon. Two species have been obtained from the former horizon, the *D. felina* and *D. squalidens*, and one from the latter, the *D. cyclops*.

Dinictis cyclops Cope.

This cat is represented by a perfect cranium with its mandible, which lacks only the posterior portions. The dentition is com-

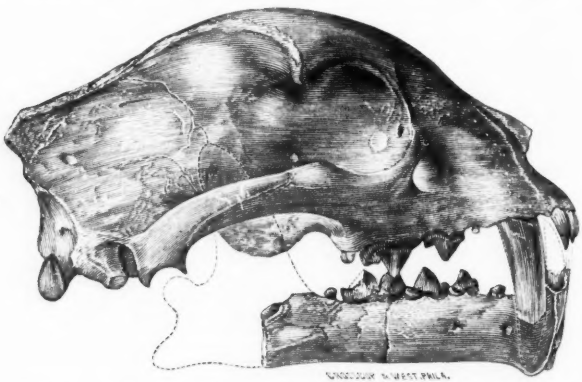


FIG. 8.—*Dinictis cyclops*, one-half natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

plete, excepting the posterior parts of the two inferior sectorials, and the apices of the canines and incisors. The condition of the specimen allows its characters to be seen with clearness. The species was as large as the fully grown Canada lynx. Although of an inferior position in the system of *Carnivora*, its powers of destruction must have excelled those of the catamount. While the skull is generally less robust, its sectorial teeth are not smaller nor less effective than those of that animal, and the canines far excel those of the living species, as instruments for cutting their prey.

Dinictis felina Leidy.

This species is known from a number of crania and jaws. The former differ in their proportions from those of the *D. cyclops*, having a relatively longer cerebral and shorter facial part of the skull. The anterior premolar teeth, especially in the upper jaw, were stronger than those of *D. cyclops*.

Dinictis squalidens.

In this species the first lower molar tooth has but one root, while in the others there are two. The canine tooth of the typical specimen has also a very peculiar form. The crown is short and wide like that of a *Carcharodon* shark, or somewhat like that of the sabre-tooth *Drepanodon latidens* Owen. As the first true molar tooth of this specimen was not fully protruded, it is possible that this canine belongs to the deciduous series.

As the tubercular tooth of the specimen on which this species was established could not be found in the jaw, I proposed to regard the species as typical of a genus distinct from *Dinictis*, remarking at the time that should such a tooth be ultimately found, the genus would have to be abandoned. Evidence of the existence of this tooth was afterwards obtained. Still later, another sabre-tooth was found with precisely the formula supposed to characterize this discarded genus (*Daptophilus*). Under the circumstances I thought best to give the former a new name, *Pogonodon*.

Pogonodon Cope.

This genus represents a station on the line connecting *Dinictis* with the higher sabre-tooths, being intermediate between the former genus and *Hoplophoneus*. It lacks the tubercular inferior molar of *Dinictis*, and possesses the second inferior premolar characteristic of that genus, which is wanting in *Hoplophoneus*. One species is certainly known, and a second is provisionally referred here. The two are the largest of the sabre-tooths of North America, the type *P. platycopis* equaling in dimensions the largest species of *Drepanodon*, being only exceeded among the true sabre-tooths by the species of *Smilodon*. Unfortunately only the skull of the typical species is known. Several bones of the *P. brachyops* have been discovered.

Pogonodon platycopis Cope.

As the greater part of the skeleton of the *Pogonodon platycopis* is unknown, little can be said as to its general proportions. The skull is one-sixth shorter than that of the usual size of the tiger (*Uncia tigris*), and is equal to the largest Brazilian variety of the jaguar, and is considerably larger than the Texan form of that species.

The development of the dentition is concentrated in the canine teeth, and the powers of destruction of the animal would seem to

be disproportioned to its ability to appropriate its prey as food. The molar teeth are rather small, as is the case with the earliest

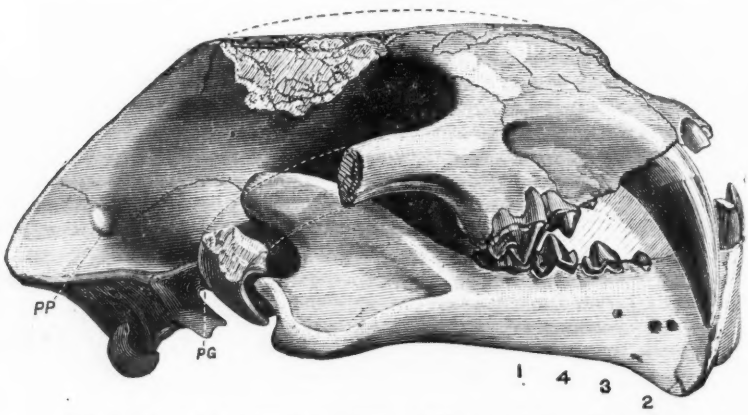


FIG. 9.—*Pogondon platycopis*, less than two-fifths natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

representatives of the canine family. The inferior sectorial is primitive and peculiar in its robust heel. We can suppose this species to have been a great destroyer of contemporary mammalian life, and that the largest ungulates of the Truckee fauna were its victims.

History. Science has hitherto had little knowledge of this species, and owes what is here recorded to a fortunate chance. The exploring party which I had sent into the John Day River valley under the direction of Mr. Jacob L. Wortman, in 1879, examined the bad-lands in the locality known as The Cove. In passing the bluffs on one occasion, a member of the party saw on the summit of a pinnacle of the crag what appeared to be a skull. The large shining objects supposed to be teeth attracted his attention, and he resolved to obtain the specimen. He, however, was unable to climb the cliff, and returning to camp narrated the circumstance. The other men of the party successively attempted to reach the object, but were compelled to descend without it, and in one case, at least, the return was made at considerable peril. A later attempt, made by Leander S. Davis, of the party, an experienced collector, was more successful. By cutting notches with a pick, in the face of the rock, he scaled the pinnacle and brought down the skull, but at considerable risk to limb and life.

Pogonodon brachyops Cope.

This was a most formidable animal, and its dental characters indicate a high degree of efficiency of both the lacerative and of the biting functions. While the *P. platycopis* has a larger development of the canine teeth, it is inferior in the relative size of

FIG. 11.

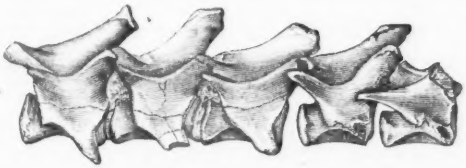


FIG. 10.

FIG. 10.—Lower jaw of *Nimravus confertus*, one-third natural size. FIG. 11.—Dorsal and lumbar vertebræ of *Pogonodon brachyops*, one third natural size. Mus. Cope. From Vol. IV, U. S. Geol. Surv. Terrs.

the sectorials. In the latter respect the *P. brachyops* resembles the species of *Nimravus* and *Archælurus*, but these are furnished with smaller or more slender canines. It, however, resembled the latter in having the feet relatively smaller than in the recent cats, a character which indicates inferior prehensile power. Unfortunately no ungual phalanges have been preserved, so that we cannot learn whether they confirmed this indication by resembling those of the *Cynælurus jubatus* or the still less specialized forms of other families.

History. This species was the first of the Oregon felines of which bones were obtained. It was first sent here by Mr. C. H. Sternberg from the Truckee Miocene bad-lands of the John Day valley, Oregon. Although I do not possess a mandible, I am satisfied that it is more nearly allied to *Dinictis* and the present genus than to *Nimravus*. It differs from the species of that genus and *Archælurus* in the following points: (1) the truncate triangular posttympanic process; (2) the transverse frontomaxillary suture; (3) the preorbital impressed depression; (4) the superior position of the postparietal foramen.

HOPLOPHONEUS Cope.

In this genus we reach the dental formula of *Drepanodon* and the true cats, while at the same time the primitive form of the

sectorials of the lower jaw remains. Three or four species only are known as yet, all from North America. We may expect, however, to find the genus in various parts of the world, wherever the beds occur which represent the time immediately preceding the epoch of the true sabre-tooths. The longest known species is the

Hoplophoneus primævus Leidy, from the White River bad-lands of Dakota and Nebraska. It is about as large as the Canada lynx, and has long and slender superior canines. A larger species, the *H. occidentalis* Leidy, from the same horizon and locality, is known from a single jaw fragment, as large as the corresponding part of the *Nimravus gomphodus*. Although the oldest members of the *Nimravidæ* yet known from North America, the *Drepanodon* characters of the mandible and of the superior canine tooth are well developed, much more so than in the false sabre-tooth group of the later Truckee epoch. In Europe, however, it must be remembered that the latter division commences still earlier, in the Upper Eocene, in the genus *Ælurogale* Filhol.

Hoplophoneus oreodontis Cope.

This species is nearly allied to the *Hoplophoneus primævus*, of which it may be only a regional variety. It is distinguished by its shorter and wider face and palate, a character especially seen in the shortness of the diastema, which is considerably less than in the Nebraska species. With this animal it compares much as the bull-dog does with the ordinary varieties of the genus *Canis*.

The two specimens I have described were found by myself on a denuded portion of the White River formation in Northeastern Colorado. At the same locality were multitudes of bones, mostly jaws, of fifty species of various orders of *Mammalia* and *Reptilia*, on many of which it doubtless preyed.

Hoplophoneus cerebralis Cope.

This peculiar species, the smallest of the genus, approaches nearest in dentition to the true sabre-tooths *(Drepanodon)*, and is represented by a skull, from which the basioccipital region, a good deal of the right side, and the lower jaw are absent. It differs in many respects from all the members of this family of cats heretofore discovered in North America. In almost every point in the osteology of the skull it is peculiar. There is not as much space for the temporal muscle as in most of the extinct

species described, or as in the large recent *Unciæ*, but the points of origin of the muscle indicate that it was relatively stronger than in the domestic cat and the lynxes. Its single premolar is very small, so that the dentition for practical use is reduced, in the upper jaw, to the canine and sectorial. Both have been most effective instruments in the performance of their respective functions. The sectorial has a distinct anterior basal lobe. The space for the accommodation of the brain is relatively more ample than in any other feline of the formation, and the inner wall indicates that the convolutions of the hemispheres were well developed. This species, if the cranium were of usual proportions, was about the size of the red lynx *(Lynx rufus)*.

The unique specimen of this species was found by Mr. J. L. Wortman in the bad-lands of Camp creek, one of the head tributaries of the Crooked river, in Central Oregon.

Hoplophoneus strigidens Cope.

Represented only by a part of a canine tooth. This tooth belonged to an animal of about the size of the *H. cerebralis*, and perhaps to that species. If so, it indicates for it a longer canine than usual, as its extremely compressed form points to a position at a considerable distance beyond the base of the crown. The probabilities are against reference to the *D. cerebralis*.

The tooth is the most elegant in form and perfect in its details yet found. As a cutting instrument it is superior to anything of human manufacture which I have seen.

Found by C. H. Sternberg on the John Day river, Oregon, in the Truckee beds.

FELIDÆ.

As defined in the preceding pages, the family of the true cats is of comparatively modern origin. We know that they existed during the Pliocene epoch, and it is very probable that they have been found in the Upper, and perhaps in Europe, in the Middle Miocene. If *Pseudælurus* and *Proælurus* pertain to it, the family dates from the Upper Eocene (Phosphorites).

Like the *Nimravidæ*, the *Felidæ* has its sabre-tooth division, with the long superior canine, reduced inferior canine, and flared lower jaw already described. In both divisions species are known which exceed in size any of those of the older family which have yet come to light. Such animals constitute the most formidable type of Carnivorous *Mammalia*.

The classification of the family is as follows:

I. The anterior and lateral faces of the mandible separated by an angle.

a. Inferior border of mandible flared downwards in front.

β. Inferior sectorial without heel; an anterior lobe of the superior sectorial, and posterior lobes of the premolars.

Premolars $\frac{3}{3}$, first inferior two-rooted.....*Drepanodon*.
Premolars $\frac{2}{2 \text{ or } 1}$; first inferior one-rooted.....*Smilodon*.

II. The anterior and lateral faces of the mandible continuous, convex. (No inferior tubercular molar.)

a. Inferior sectorial without heel; premolars with posterior lobes; superior sectorial with anterior lobe.

β. Superior sectorial without internal heel; ungual phalanges without inferior process.

Pupil round, premolars $\frac{3}{3}$; orbit open posteriorly.....*Cynælurus*.

ββ. Superior sectorial with internal heel; ungual phalanges with inferior process.

γ. Pupil round.

Premolars $\frac{3}{3}$.....*Uncia*.
Premolars $\frac{1}{1}$.....*Neofelis*.

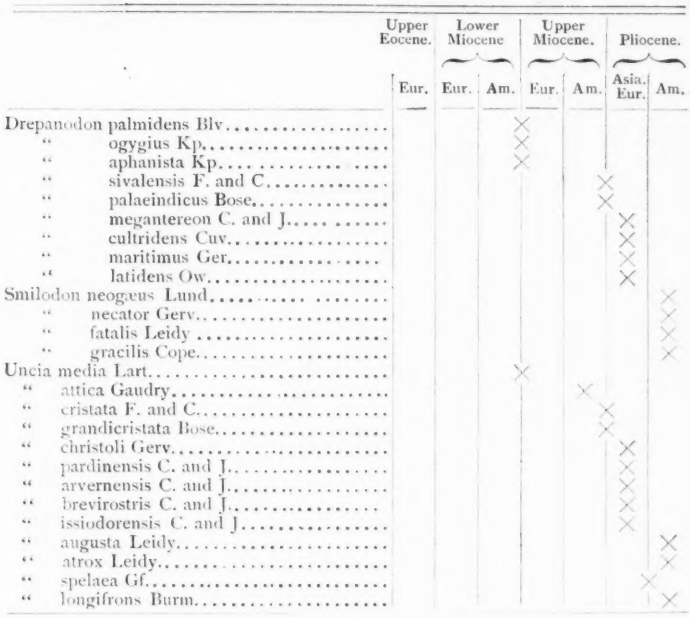
γγ. Pupil vertical.

Orbit closed behind; premolars $\frac{3}{3}$.....*Catolynx*.
Orbit open; premolars $\frac{3}{3}$.....*Felis*.
Orbit open; premolars $\frac{1}{1}$.....*Lynx*.

The tendency to reduction of the number of molar teeth is seen in the above genera, as already pointed out in the *Nimravidæ*.

The only extinct genera are *Drepanodon* and *Smilodon*. Of the other genera the greater number of extinct species belong to *Uncia*.

The following catalogue of species and their distribution shows that but few of the extinct *Felidæ* have yet been found in North America. A star on a line between two columns shows an intermediate stratigraphical position. The extinct true cats whose crania have been discovered, belong to *Uncia*, but it is possible that some of the European species, which are as yet only known from lower jaws, may be species of the genus *Felis* or *Lynx*.



As already remarked, the genera of the Nimravine and Drepanodont lines are extinct, and this in spite of the fact that they presented the most perfect weapons of destruction in their canine teeth, from the earliest times. Their other modifications of structure advanced, *pari passu*, with those of the feline series, and, among others, the feet presented in the latter forms at least (*e. g.*, *Smilodon necator*, Gerv.), the most perfect prehensile power of the lions and tigers of to-day. As nothing but the characters of the canine teeth distinguished these from the typical felines, it is to these that we must look for the cause of their failure to continue. Prof. Flower's suggestion appears to be a good one, viz: that the length of these teeth became an inconvenience and a hindrance to their possessors. I think there can be no doubt that the huge canines in the *Smilodons* must have prevented the biting off of flesh from large pieces, so as to greatly interfere with feeding, and to keep the animals in poor condition. The size of the canines is such as to prevent their use as cutting instruments, excepting with the mouth closed, for the latter could not have been opened sufficiently to allow any object to enter it from the front.

Even when it opens so far as to allow the mandible to pass behind the apices of the canines, there would appear to be some risk of the latter's becoming caught on the point of one or the other canine, and forced to remain open, causing early starvation. Such may have been the fate of the fine individual of the *S. neogæus*, Lund, whose skull was found in Brazil by Lund, and which is familiar to us through the figures of De Blainville, etc.

Drepanodon Nesti. (*Machærodus* Kaup).

This genus as understood by most authors, belongs to the later Miocene and Pliocene, and has had numerous representatives in Europe and Asia. No species has as yet been found in America. Some of the species described by authors are only known from fragments, so that much remains to be ascertained as to the prevalence among them of the characters I have assigned to the genus and family. Those given are derived from the two species best known, the *D. cultridens* and *D. megantereon*, which have been readily obtained from the descriptions and figures of authors.

It is difficult to ascertain the number of European species. Pomel's catalogue is generally cited, and this is, with some subtractions and additions, the basis of the list already given.

Smilodon Lund.

Besides the family characters already given, this genus differs from the *Nimravidæ* in two other important respects. In both points it differs also from such existing members of the *Felidæ* with which I have been able to compare it. In both *S. fatalis* and *S. necator*, the posttympanic process of the skull is coössified with the postglenoid, thus closing the auricular meatus below. It thus differs from other *Felidæ* as the genus *Rhinocerus* differs from various other members of *Rhinoceridæ*. The second point has been indicated by Prof. Gervais. There is no epitrochlear arterial canal, such as belongs to cats and *Nimravidæ* generally. This I have only verified on the *S. necator*.

This genus represents in America the Drepanodons of the Old World. The known species belong to the Pliocene period, and were the cotemporaries of the gigantic sloths and *Glyptodons*, which at that time ranged over the entire American continent. Their powerful limbs terminated by immense claws, bespeak for them exceptional force in striking and tearing their prey, and the long compressed canine teeth are well adapted for penetrating the

tough hides and muscles of the large Edentata, which were doubtless their food. There are known two species of large size from

FIG. 13.—*Smilodon necator* Gervais, one-third natural size. Original. Mus. Cope.

the Pliocene of South America, and probably two species from North America. A figure of the skeleton of the *S. necator* Gervais accompanies this paper. It is a copy of a lithograph taken by Prof. Burmeister from a specimen in the Museum of Buenos Ayres. The second known skeleton, found by M. Larroque near to the village Areco, a few miles west of Buenos Ayres, is in possession of the writer. Lateral and inferior views

of the skull of this individual, one-third of the natural size, are represented in figures 13 and 14.

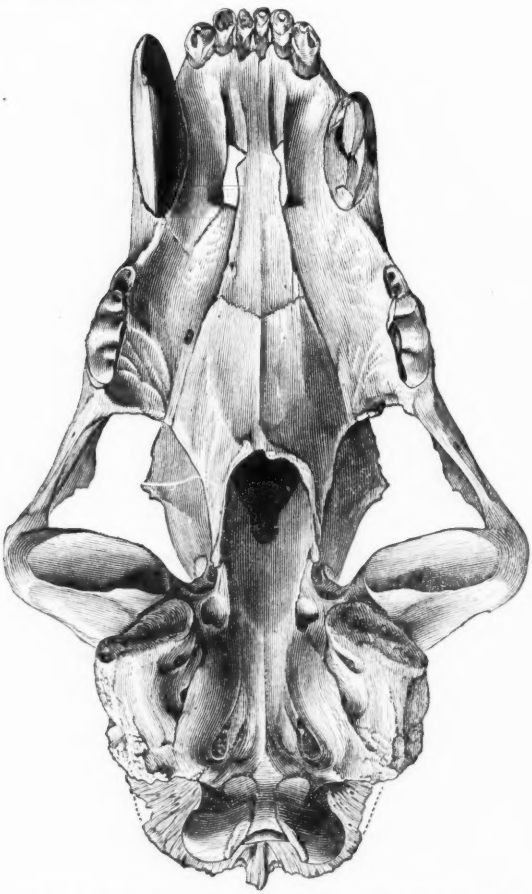


FIG. 14.—*Smilodon necator*, one-third natural size. Inferior view of skull Fig. 12.

This specimen is the one on which the late Prof. Gervais based his determination of the species (*Comptes Rendus*, 1878, June), but which he had not described at the time of his death. The species is about the size of the lion, and of the most formidable character.

A fragment of a maxillary bone containing a sectorial tooth found in Texas was referred to an extinct cat, by Prof. Leidy, under

the name of *Trucifelis fatalis*. As it possesses a second anterior basal lobe of the superior sectorial, it is doubtless a *Smilodon*. I am confirmed in this opinion by the characters presented by an important specimen sent me by G. W. Marnock, who obtained it in Southwestern Texas. It consists of that portion of a cranium, which is posterior to the orbits, and represents an animal of the size of the *S. necator*, or of a large tiger. The positions of the foramina and the conjunction of the posttympanic and postglenoid processes are as in the *S. necator*. When more of this species is known, it will doubtless be found to be our largest sabre-tooth.

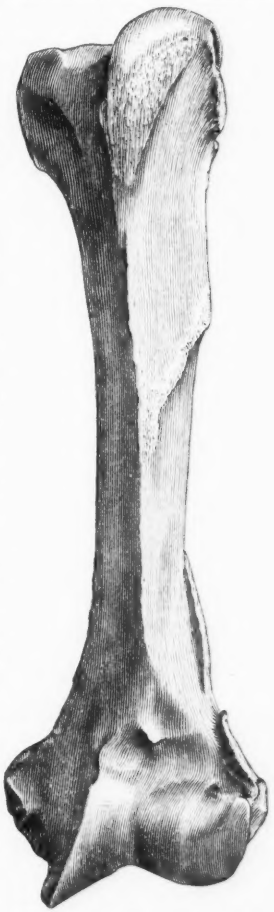


FIG. 15. — *Smilodon necator;* humerus of specimen Figs. 12, 13, from front, one-third natural size. Mus. Cope.

Among the remains obtained by Charles M. Wheatley from a cave on the Schuylkill river, in Pennsylvania, which I described in 1871, there occurred a part of the canine of a sabre-tooth. Hoping to obtain better specimens, I did not include it in the published lists. Having established the existence of the genus *Smilodon* as a contemporary of the sloths during the Pliocene period in North America, it becomes probable that the species of the caves is also to be referred to it. The canine in question has lost most of its crown. It is of smaller size than that of either of the three species previously mentioned, and its basal portion is more compressed. This compression is a marked character, and I refer to it the name *Smilodon gracilis*, by which the species may be known.

UNCIA Gray (Cope emend.).

Extinct species of this genus have been found in the late Miocene and subsequent deposits in India, Europe and North America. It is distinguished from the

true *Felis* by the round form of its pupils. This can only be observed in the living species, so that some correlated index of it must be used in determining the genus from skulls. This Dr. Gray shows is seen in the small size of the orbits, which are always less than those of the species of *Felis.*

Fragmentary remains from the Loup Fork formation of Nebraska and the Pliocene and Quaternary of Mississippi and California have been described by Leidy under the names of *Felis augustus, F. atrox* and *F. imperialis.* Dr. Leidy suggests that there may have been two species, the one *(F. augustus)* characteristic of the Loup Fork epoch, and *F. atrox,* the second, belonging to a later period. The *Uncia augusta* was intermediate in size between the *U. onca* and the tiger, while the *Uncia atrox* was, according to Leidy, larger than the lion or tiger. It represents in America the *Uncia spelea* of the European caves, and should be carefully compared with that species.

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TWIN LAKES AND TEOCALLI MOUNTAIN, CENTRAL COLORADO, WITH REMARKS ON THE GLACIAL PHENOMENA OF THAT REGION.

BY F. V. HAYDEN.

ONE of the most interesting localities in Central Colorado, is the Twin lakes. These lakes are situated at the point where Lake Fork issues from the Sierra Madre, or Wasatch range, into the short valley which opens into the Upper Arkansas. At no distant period this point, with its surroundings, will form one of the most popular and desirable watering places in the West; already every available spot in the vicinity has been purchased for the purpose of erecting summer houses. The elevation of the lakes is 9357 feet above sea level. Some of the loftiest peaks in Colorado are in full view of the surrounding hills. Massive mountain, Mt. Elbert, Harvard, Yale and Princeton peaks, rise to heights of over 14,000 feet. The massive granite mountains on every side, are among the most rugged and picturesque in the Rocky Mountain region.

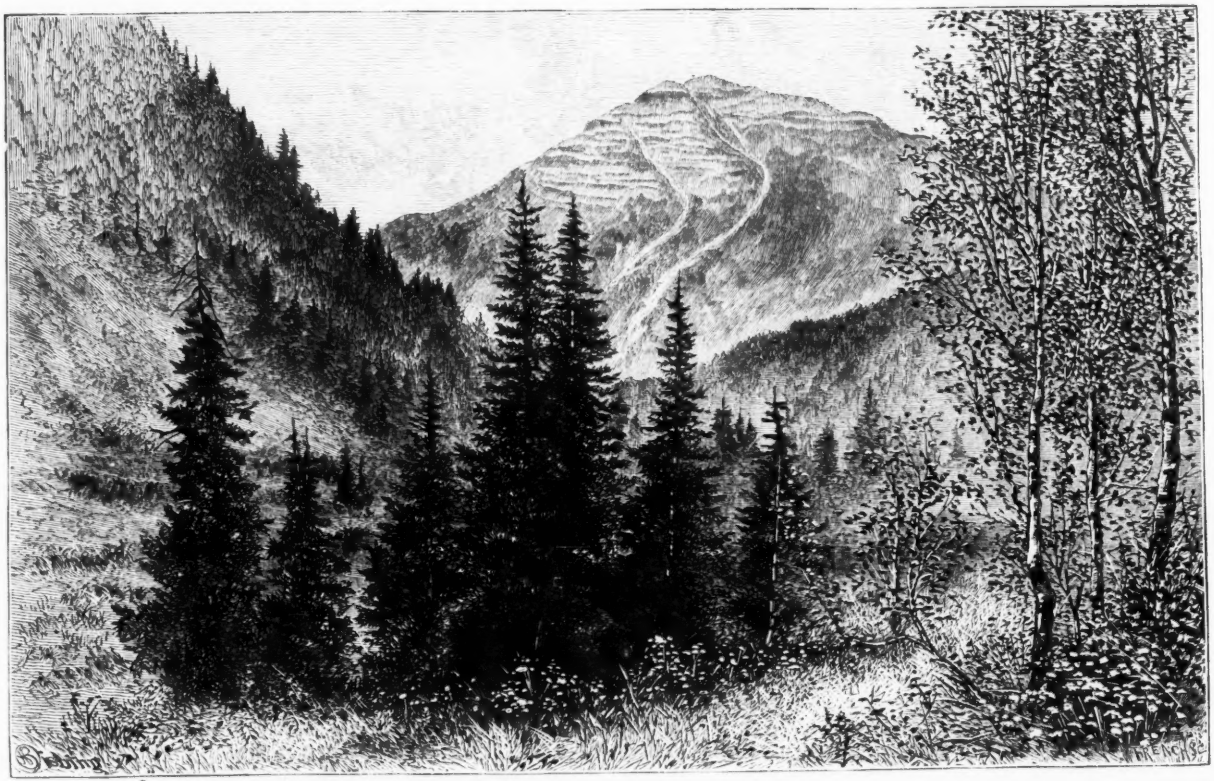
During the survey of this region in 1873, under the direction of the writer, these lakes were carefully sounded, and their greatest depths were found to be respectively seventy and seventy-six feet. These are formed in basins, as it were, which

Upper Twin Lake, Central Colorado.

were undoubtedly scooped or worn out of the granite rocks by glacial action. They afford a splendid example of what Prof. Ramsay, the eminent geologist of England, calls "Rock Basins," the origin of which he has so graphically explained in his volume on the "Physical Geography and Geology of Great Britain." In the Upper Arkansas valley there seems to have existed in glacial times, one immense glacier, rising to the height of 1000 to 1500 feet on the mountain sides, and filling up the entire valley, with tongues or branches extending up the numerous side cañons. A description of this remarkable district may be condensed from the Report of the U. S. Geol. and Geog. Survey of the Territories for 1873 and 1874. The Arkansas valley, from its head in Tennessee pass to the point where the river cuts through the Front or Colorado range and opens out into the plains, has been worn out of the granite mass to a great extent. The origin of this valley is mostly due to erosion. From the crest of the Park range, on the east side of the Arkansas river, to that of the Wasatch on the west, the average distance in a straight line must be at least ten or fifteen miles, and the average elevation above the water level of the river 1500 feet. It is probable that this great space was, at no very ancient period, filled with one vast glacier, which doubtless performed the greater part of the grinding up of the rocks and the wearing out of the valley. The glacier-worn sides of the gorges, point strongly to that conclusion.

But in this brief article we must confine ourselves mostly to the limited district, the valley of Lake Fork, in which the Twin lakes are located, the subject of the illustration. The valley of Lake creek is filled with the morainal deposits for which both sides of the Wasatch range of mountains are so remarkable. It would seem that the great glacial force moved here in a direction a little south of east, inasmuch as the mass of the detrital matter is heaped up on the south side. The two lakes are about three hundred and fifty yards apart, with a small stream flowing from the upper into the lower, about twenty feet in width. The interval is made up of worn detrital matter, but over it and around both lakes, are mounds or oblong ridges of drift; and scattered over the surface, are masses of granite, coarse in texture, with crystals of feldspar, one and two inches in diameter, aggregated together. The rock has the appearance of a feldspathic breccia. The lower lake is about two and a-half miles in length

and one and a-half miles in width, the upper lake is one mile in length and a-half mile in width. As we have stated before, the greatest depth was found to be seventy to seventy-six feet. The Lake creek rises about twelve or fifteen miles away, at the crest of the Wasatch range, and flows through a deep gorge or cañon, with signs of glacial erosion its entire length, and as it issues from the mountains into the main valley, has become a considerable stream. These lakes are really expansions or basins in this stream and a part of it. That these lakes have been slowly diminishing in area, we know by the land bordering on both of them. Above the Upper Twin lake, there is a half mile in width of boggy meadow, which at no distant period must have been covered by the lake. At the head of the valley, or where the gorge begins, there is a sort of natural bridge, where the stream has worn a narrow channel through the rocks. At the summit the gorge is about eight feet wide, and in it a huge boulder has lodged. The stream rushes down its steep, narrow, winding channel with great force. On the north side there is a huge boulder just ready to topple off into the channel, which is fifty feet in diameter. On the sides of the channel are several most remarkable rounded cavities worn in, like pot holes, six to ten feet in diameter. One of these occurs twenty feet above the water level of the creek at the present time. The worn rocks, or *roches moutonnes*, are most admirably shown everywhere, and portions crop out in the bottom of the valley to indicate the force as well as the extent of the erosion. It is quite possible that if all the *débris* could be stripped off the gorge and valley, the grooved or scratched surfaces would be apparent. One immense mountain mass on the north side seems to have resisted the eroding forces, so that from base to summit, a heighth of one thousand feet, it is smooth, like enamel. The great glacier which must have filled up the channel, has probably been obstructed, in its slow downward movement, by this projecting point of the mountain. The great branch glaciers of Lake creek must have been at least 1500 feet thick. The valley or gorge is of nearly uniform width, about one-fourth of a mile, and the glacier must have ploughed its way along, removing a great thickness of the gneissic rocks on either side and on the bottom, rounded remnants of which can be seen cropping everywhere from the detritus. About six miles above Twin lakes, in a straight line, Lake creek forks, one branch extending up toward the north-west, and the other south-west.



Teocalli Mountain, Central Colorado.

Both separate again soon into a number of smaller branches, which end in amphitheaters near the crest. There is not space here to dwell in detail on the remarkable features of this region. The student will find here the most wonderful examples of erosion, and an almost unlimited view of varied glacial phenomena; the lover of sport can find abundant trout fishing in the lakes and various kinds of game in the mountains; the invalid, pure air and water, so that at no distant period the region about Twin lakes must become a famous resort for seekers after health and pleasure.

Teocalli mountain.—On the west side of the Main or Wasatch range, in a nearly direct line from the Twin lakes, is a mountain peak of very singular but interesting appearance. This peak forms the subject of our second illustration. The name was given this peak by the Survey on account of its resemblance to the celebrated sacrificial mound of Mexico. The mass of rock seems to have been elevated by forces acting in a vertical manner so that the strata are nearly or quite horizontal, yet its summit is 13,131 feet above sea level. The peculiar form is pyramidal and the strata of various colored sandstone and clays are so arranged as to form a series of steps from base to summit. The texture of the rocks is quite varied, from a fine sandstone or quartzite to a conglomerate interlaid with thin seams of clay, which is weathered out so as to permit the harder beds to project out like steps. There is an enormous thickness of these variegated beds, and while a great portion may be of the age of the Jura-trias, the lower portion is believed to belong to the era of the Permian, or Permo-carboniferous. From this point can be seen distinctly the remarkably picturesque forms of Pyramid, Maroon and other mountains, rising to an elevation of over 14,000 feet, yet composed of nearly horizontal beds of these variegated rocks. The prevailing color is a dull red or purple. Maroon peak, 14,003 feet above sea level, receives its name from its prevailing color. Great numbers of these peaks, which in the aggregate, form the celebrated Elk Mountain range of Central Colorado, seem to have been originally thrust up through the overlying Cretaceous and Tertiary beds with the utmost irregularity, producing a series of faults and overturnings of strata, equalled in very few localities on this continent. Teocalli mountain does not present the appearance of having been eroded since the uplift, and the vast

thickness of superincumbent strata may have been removed prior to its elevation, but we know that at least 10,000 feet of more modern beds, at one period rested upon it. The illustrations accompanying this paper will serve to convey some idea to the reader of the unique scenery which abounds in the mountain regions of Central Colorado.

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A SKETCH OF THE PROGRESS OF BOTANY IN THE UNITED STATES IN THE YEAR 1879.

BY PROF. C. E. BESSEY.

A. Anatomy and Physiology.—In this department the observations of the botanists of this country, as shown by their published papers, were directed mainly to the reproductive organs and their functions; and with one or two exceptions the papers were short, involving but a few quickly-made observations. Little or no work was done in micro-anatomy (histology) and proper physiology.

While we may regret that so much of the field has been so sadly neglected in our country, we should remember, that as a rule our botanists are overloaded with other duties which render it often impossible for them to command the time for making the necessary investigations.

In the January number of the NATURALIST, Prof. J. E. Todd published a paper "On Certain Contrivances for Cross-fertilization in Flowers," illustrated by eight wood-cuts, in which he described the modes of pollination in Martynia, Penstemon and Lobelia, and added a few observations upon the structure of the Iris flower. In the same journal Mr. William Trelease published (p. 427) a paper "On the Fertilization of several species of Lobelia," and another (p. 688) on "The Fertilization of our native species of Clitoria and Centrosema," both illustrated by several cuts. Thomas Meehan's paper "On the Fertilization of Yucca," read before the American Association for the Advancement of Science, is interesting from the fact that it shows that in Yucca, where we appear to have so perfect an adaptation of flower and insect *(Pronuba yuccasella)*, pollination may still be effected by other and unusual means.

Prof. W. J. Beal described in the *American Journal of Science and Arts* for May, some "Experiments in Cross-breeding plants

of the same Variety." Of Indian corn and wax beans, two lots of each were obtained from widely different localities; these were so planted as to secure cross-fertilization in certain cases, and fertilization without crossing in others. The result was shown to be highly favorable to the crossed plants.

Dr. M. E. Elrod's paper on the "Seeds of the Violet and other plants as Projectiles," in the February NATURALIST, and that of R. E. C. Stearns in the July number of the same journal, on "The Form of Seeds as a Factor in Natural Selection," contribute somewhat to our knowledge of the means for the distribution of the seeds of plants.

Of other papers in this department, the following may be mentioned: "Trimorphism in *Lithospermum canescens*," by Mr. E. F. Smith in the *Botanical Gazette* for June; "Sexual differentiation in *Epigæa repens*," by Mr. L. F. Ward; "Note on the movement of the stamens of *Sabbatia angularis*," by the same author, both read before the American Association for the Advancement of Science; "Objects of Sex and Odor in Flowers," by Thomas Meehan, read before the A. A. A. S., and printed in the *Scientific American*, Oct. 1879, pointing out that "variation is not merely an incident of form, but that it must necessarily be a primary object in nature; that the institution of sex is but an incident in the primary law of variation; and that all the machinery for fertilization and cross-fertilization is with the object of causing a change of form far in the future, and with no material bearing on the good of the individual, or even of the race." Here should be mentioned Prof. Tuckerman's paper, "The Question of the Gonidia of Lichens" (*Am. Jour. Sci. and Arts*, March, 1879), a review of Dr. Mink's recently published observations. The reviewer gives a short résumé of the lichen-gonidia controversy, and records some observations of his own, which he regarded as confirmatory of those of Dr. Minks.

B. Systematic Botany.—a. Fungi.—One of the most important contributions in this department is Mr. C. H. Peck's "Report of the Botanist" in the Thirty-first Annual Report of the New York State Museum of Natural History. This report, although bearing date of January, 1878, was actually not published until 1879. Many new species of Fungi (mostly Basidiomycetes and Ascomycetes) are described. One of the most interesting of these is the one which lives parasitically within the abdomen of the seventeen-

year Cicada, and which Mr. Peck proposes to put into the new genus *Massospora*, which he briefly characterizes. The table giving the synonymy of the Myxomycetes of New York, and the critical notes which follow are valuable, especially to those who do not have access to Rostafinski's work.

In the "United States Species of Lycoperdon," a paper read Feb. 4, 1879, by Mr. C. H. Peck, before the Albany Institute, we have the first approximately complete account of the puff-balls of this country. The paper opens with a general description of puff-balls, covering six pages. This is followed by a synoptical table of the species, which are arranged under two sections, viz: *Bovistoides* and *Proteoides*, according as the peridium ruptures irregularly or regularly. The excellent specific descriptions which follow in the body of the paper, are based upon Mr. Peck's personal observations, and these are supplemented by remarks upon the general and more obvious characters, as well as the distinguishing features of such species as are closely allied and liable to be confused. Nineteen species are thus described in full, and four others, known to occur in the United States, but not seen by Mr. Peck, are more briefly noticed at the end of the paper. A list of publications consulted closes this valuable contribution.

The same indefatigable mycologist, in several short articles in the *Botanical Gazette*, described thirty-eight new species from various parts of the United States. Of these twenty are Uredineæ, six Hymenomycetes and four Gasteromycetes.

M. C. Cooke, in the March number of *Grevillea* described several new species from California, and in the September number of the same journal, Mr. Cooke and J. B. Ellis described thirty or more new Fungi from New Jersey.

Baron Theumen's short contribution in the October Bulletin of the Torrey Botanical Club, contained descriptions of several new species.

In F. B. Hine's "Observations on Several Forms of Saprolegnieæ," begun in the October (1878) *American Quarterly Microscopical Journal*, and concluded in January, 1879, we have one of the first records of a careful study of the plants of this interesting order in this country. Four plates, filled with many figures, accompany the paper.

J. B. Ellis' paper "On the Variability of *Sphæria quercinum*

Schw.," published in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1879, p. 66, shows the growth of a healthy critical spirit, the author having satisfied himself that the species named includes thirteen or more forms hitherto regarded as distinct species.

Dr. Farlow's lecture on "The Diseases of Forest Trees," an abstract of which was published in the Transactions of the Massachusetts Horticultural Society (1879), consists of a plain account of the fungoid growths upon forest trees. As a contribution to the popular economic mycology of the United States, this lecture is to be regarded as a most valuable one.

Thomas G. Lea's list of "The Fungi collected in the vicinity of Cincinnati," originally published in 1849, was republished with a few additions, by J. F. James in the Journal of the Cincinnati Society of Natural History, 1879. In its revised form it includes 319 species.

Of the two American *exsiccati* now publishing, Centuries III and IV of Ravenel and Cooke's Fungi Americani appeared early in 1879, and Centuries II and III of Ellis' North American Fungi.

b. Algæ.—In the Proceedings of the Boston Society of Natural History, 1879, Dr. B. D. Halsted published a valuable paper on the "Classification and Description of the American species of Characeæ." Eight species of Nitella, one of Tolypella and nine of Chara are fully described. The references to descriptions and *exsiccati* appear to be full, and the geographical distribution of the species is as well worked out as the material at the command of the author would admit. A valuable list of the works consulted in its preparation is found at the end of the paper.

Dr. T. F. Allen's "Characeæ Americanæ," of which Parts I and II were issued in 1879, is another valuable contribution to our knowledge of the hitherto little studied American species of the Characeæ. Each part consists of a colored lithograph of a species accompanied by descriptive letterpress.

"The Seaweeds of Salt lake," is the title of a short article by Dr. Packard in the November NATURALIST. It is composed mainly of Dr. Farlow's preliminary report upon a collection of Algæ obtained by Dr. Packard from the Great Salt lake of Utah. Two of the species are recognized as marine forms, while the third is new.

Francis Wolle, in an article entitled "Dubious character of

some of the genera of fresh water Algæ," published in the *American Quarterly Microscopical Journal*, records some of his observations upon the unicellular forms of vegetation occurring in fresh water, and "questions the place given them as plants," and suggests that many of them "are merely forms of gonidia or spores or sporangia, various stages of development in the life history of filamentous plants." The same writer, in the Bulletin of the Torrey Botanical Club (January and February, 1879), published a "Synopsis of the Discoveries and Researches of fresh water Algæ in 1878," in which some American species are, for the first time, described, and many others catalogued.

Fasciculus III of Algæ Exsiccatæ Am. Bor., containing thirty species of the larger algæ (Fucaceæ and Florideæ) was issued by the authors, Farlow, Anderson and Eaton, during the year 1879.

c. Lichens.—But little appears to have been published in 1879 by the lichenologists of this country. Prof. Tuckerman's list of the lichens in Dr. Rothrock's "Catalogue of the plants collected in Nevada, Utah, California, Colorado, New Mexico and Arizona" (Wheeler's Report, Vol. VI) is the only publication in this department which has come to hand.

d. Bryophytes (Mosses and Liverworts).—In the catalogue just referred to above, Thomas P. James enumerates seventy-nine species of mosses, and C. F. Austin fifteen species of liverworts. In Mr. James' list the less known species and genera are described, and to nearly all short notes upon habit or habitat are appended.

"Descriptions of some new species of North American Mosses," by Leo Lesquereux and Thomas P. James (Proc. Amer. Academy of Arts and Sciences, 1879), includes the descriptions of fourteen new species, mostly from the Southern and Western States.

Under the titles of "Some New Musci" (*Botanical Gazette*, April, 1879), "Bryological Notes" (Bull. Torr. Bot. Club, Sept., 1879), and "Notes on Hepaticology" (Ibid, April, 1879), the lamented C. F. Austin described a considerable number of new mosses and liverworts.

e. Pteridophytes (Vascular Cryptogams).—It is a pleasure to direct the attention of botanists to the industry of Prof. Eaton, whose "Ferns of the Southwest" (Wheeler's Report, Vol. VI), "The Ferns of North America" and "New and little known Ferns of the United States" (Bull. Torr. Bot. Club, pp. 306, 360), appeared wholly or in part in 1879. The first includes descrip-

tions of all the less known ferns of the Southwest, *i. e.*, the Utah-Arizona region. In all sixty-six species are noticed, and one figured in Plate xxx. It should be remembered that while the preface to the work bears the date of 1877, the date of its actual appearance in the volume of which it forms a part is properly 1879. A few copies were separately distributed some time in advance of the publication of the whole report, but the exact date of this distribution is not known to the writer of this paper. The great work on the "Ferns of North America" with its fine colored plates was nearly brought to a close during the year 1879. It will forever remain a monument to the ability of its author.

In "Fern Etchings," by John Williamson we have a notable example of the good work which may be done by the painstaking lover of plants. The volume contains plates of sixty-eight ferns of the United States, with letterpress descriptions of each.

G. E. Davenport's "Catalogue of the 'Davenport Herbarium' of North American Ferns" is interesting as being the first complete catalogue of the ferns of this country. It contains one hundred and forty-two species, besides sixteen varieties.

Among other publications, Mr. J. F. James' list of vascular cryptogams in his catalogue of Cincinnati plants, above referred to, and Prof. J. W. Chickering's list in his catalogue of the plants of Dakota and Montana (Bull. U. S. Geol. and Gograph. Survey, Vol. IV), deserve mention. Baron Eggers' similar list, in his "Flora of St. Croix and the Virgin islands" (Bull. U. S. Nat. Museum) should also probably be noticed here.

f. Phanerogams.—The most notable contribution in this department is the "Report upon the Botanical Collections made in portions of Nevada, Utah, California, Colorado, New Mexico and Arizona, during the years 1871 to 1875," by Dr. J. T. Rothrock, being Vol. VI of the Reports upon the U. S. Geographical Surveys west of the 100th meridian, in charge of Lieut. Wheeler. The work contains a General Report, in which the general features of the flora of the Colorado and the New Mexico districts are separately described. This portion also contains some valuable and interesting notes upon economic botany. The main part of the work consists of the catalogue proper. This is modeled after Sereno Watson's "Botany" of the Clarence King Reports. All the genera and species not contained in Gray's Manual, or in Watson's Botany, are here fully described.

While Dr. Rothrock bore the burden of the work, he availed himself freely of the aid of such excellent botanists as Mr. Watson, who worked out the Leguminosæ, Dr. Engelmann (Cactaceæ, Asclepiadaceæ, Gentianaceæ, Cuscuteæ, Euphorbiaceæ, Cupuliferæ, Loranthaceæ, Coniferæ, Amaryllidaceæ and Juncaceæ), Prof. Porter (Polemoniaceæ, Borraginaceæ, Scrophulariaceæ, Labiatæ and Polygonaceæ), M. S. Bebb (the genus Salix), Wm. Boot (the genus Carex) and Dr. Vasey (the Gramineæ). Twenty-nine excellent plates of flowering plants, mostly from drawings by Isaac Sprague, accompany the volume.

Dr. Gray's "Botanical Contributions" (Proc. Am. Acad. of Arts and Sciences) contained (1) "Characters of some new species of Compositæ in the Mexican collection made by C. C. Parry and Edward Palmer, chiefly in the Province of San Luis Potosi, in 1878," and (2) "Some new North American Genera, Species, &c." The new genera are *Suksdorfia*, a Saxifragaceous genus from the Columbia river, and *Howellia* (Lobeliaceæ) from Oregon.

Sereno Watson's "Contributions to American Botany, IX" (Proc. Am. Acad. of Arts and Sciences), issued July, 1879, contained (1) a "Revision of the North American Liliaceæ," and (2) "Descriptions of some new species of North American Plants." Under the first part, the fifty genera and two hundred and thirty-five native species are arranged and described. The whole order, which here includes the Melanthaceæ, is divided into sixteen tribes, "based upon the characters of the inflorescence, and such others as can be used without separating evidently allied genera." The Allieæ come first, then the Milleæ, Convallarieæ sixth, Yucceæ ninth, with Lilieæ, Uvularieæ, Trillieæ, Veratreæ following in order, and the Xerophylleæ at the end. In the second part the new genus *Hollisteria* (Eriogoneæ) is described.

"The Willows of California," by M. S. Bebb, issued July, 1879, consists of advance sheets of the "Botany of California, Vol. II." Six new species and seven new varieties are described.

Wm. M. Canby, in the *Botanical Gazette* for March, published under the title of "Notes on Baptisia," a valuable synopsis of an arrangement of the North American species, sixteen in number.

Among the lists of plants the following may be mentioned, viz: Prof. J. W. Chickering's "Catalogue of the Phænogamous and vascular Cryptogamous Plants collected during the summer of 1873 and 1874 in Dakota and Montana," published in Bull. U. S. Geol. and Geog Survey, Vol. IV; this enumerates 673 flowering

plants; J. F. James' "Catalogue of the Flowering Plants, Ferns and Fungi growing in the vicinity of Cincinnati," with 869 flowering plants; "Colorado Plants," a list of plants collected in Central and Southern Colorado, by I. C. Martindale, published in the November NATURALIST, with notes upon the rarer species; "Ballast Plants in New York city and its vicinity," by Addison Brown, in the November Bull. Torr. Bot. Club, enumerating 258 species.

Here must be mentioned the fine work by Thomas Meehan, "The Native Flowers and Ferns of the United States," consisting of chromo-lithographs with explanatory letter-press. This work continued to be issued in parts through the year.

Baron H. F. A. Eggers' "Flora of the St. Croix and Virgin Islands," published in Bull. U. S. Nat. Museum, should probably be noticed here. It enumerates 977 flowering plants.

C. Geographical and Geological.—Under the title of "A Visit to the Shell islands of Florida," A. H. Curtiss, in the February, March and May numbers of the *Botanical Gazette*, gives an interesting account of the vegetation of these little-visited islands. Much like this also is J. H. Redfield's "Notes of a Botanical Excursion into North Carolina," in the July and August numbers of the Bull. Torr. Bot. Club. In the party were Dr. Gray, Prof. Sargent, Mr. Canby and others, and one important object of the excursion was the finding of more specimens of Shortia.

"The Forests of Central Nevada, with some remarks on those of the Adjacent Regions," by Prof. C. S. Sargent, in the June *Am. Jour. Sci. and Arts*, contains notes upon the trees of the region, and comparative lists of the ligneous floras of the Rocky mountains, the Nevada and the Sierra Nevada regions. Much like the foregoing in treatment, but referring to very different plants, is Dr. Gray's paper, "The Pertinacity and Predominance of Weeds," in the September *Am. Jour. Sci. and Arts.*

In the Bulletin of the U. S. Geol. and Geographical Survey, Vol. v, W. H. Holmes contributes an interesting article on the "Fossil Forests of the Volcanic Tertiary Formations of the Yellowstone National Park." In some places the aggregate thickness of the strata reaches more than one vertical mile (5500 feet), and throughout these strata are found vast numbers of silicified remains of tree trunks. The article is accompanied by a figure of the north face of Amethyst mountain, showing a precipice composed of upwards of two thousand feet of strata.

In the *American Journal of Science and Arts* for April, Leo Lesquereux published a review under the title, "Notice of Gaston de Saporta's Work: 'The Plants of the world before the advent of man,'" which is to be regarded as a real contribution to Phytopalæontology.

Dr. Dawson's paper "On Tertiary Plants," published in the Report of the Geological Survey of Canada for 1879 has not been seen by the writer of this article.

D. Historical.—"The Chronological History of Plants: Man's record of his own existence illustrated through their names, uses and companionship," by Charles Pickering. In this large volume the author aimed to present in a condensed form all that is known as to the plants used by or spoken of by the ancients. It is a monument to the patience and industry of its lamented author.

Of a very different nature is Frederick Brendel's "Historical Sketch of the Science of Botany in North America from 1635 to 1840." (AM. NATURALIST, p. 754). Beginning with Cornut's *Canadensium Plantarum Historia*, 1635, "the first book on North American plants ever written," the author notices in chronological order the publications relating to American botany down to the year 1840.

E. Text Books.—Two notable text books made their appearance during the year, viz: Gray's "Botanical Text Book: I.—Structural Botany," and Goodale's "Concerning a few Common Plants." The first is the now well-known revision of the old Botanical Text Book. It is unnecessary to describe it; it at once took rank as one of the best books on structural botany extant. The second book is unfortunately less widely known. It was prepared as a supplement to a series of lectures to the teachers in the public schools of Boston and vicinity. As an aid to the earnest teacher seeking for the best methods of presenting the more important facts in the structure and physiology of the flowering plants, this little book is a valuable contribution.

F. Periodical Publications.—The two purely botanical journals of this country, *The Bulletin of the Torrey Botanical Club* and *The Botanical Gazette*, continued throughout the year without any marked change in their character.

The same may be said of the botanical departments of the AMERICAN NATURALIST and the *American Journal of Science and Arts.*

Two journals, in which botanical articles frequently appeared, ceased publication for want of adequate support, viz: *Science News* and *The American Quarterly Microscopical Journal.*

A SKETCH OF COMPARATIVE EMBRYOLOGY.

BY CHARLES SEDGWICK MINOT.

V.—THE GENERAL PRINCIPLES OF DEVELOPMENT.

THE sponges present, as we have seen, many exceptional peculiarities in their development. All the remaining Metazoa, on the other hand, may be treated as members of one series, which are governed by several general laws of embryonic growth, only a portion of which can, at present, be said to apply to the sponges.

The fundamental law of embryology is, that the simple precedes the complex, the general and typical, the special. All embryos obey this principle in their early growth, and most of them throughout all their growth; but some, after advancing to a certain stage, stop, or suffer a degeneration as it is technically called—in other words, only a part of their organs continue to develop; or even the whole animal retrogrades, *i. e.*, becomes simpler. Of degeneration,[1] the Crustacea offer many instances—one of the most familiar is the common barnacle, which in its young or larval state swims about the ocean freely, having well developed limbs and sense organs, but later loses some of its structures, becoming in its adult condition permanently attached to the rock. Almost all parasitic forms are degraded. In spite of these instances, progress is primary and universal, degeneration secondary and exceptional. In all cases the embryos present to us animals stripped of the secondary modifications found in adult life, and exhibiting the more essential peculiarities. Thus in very young birds we plainly recognize the gill slits and arches corresponding to the gills of fishes, but in the adult bird the gill slits have disappeared, and the arches so metamorphosed, that without knowing the embryo it would hardly be possible to discover their real connections, and their identity with the corresponding structures of fish. Embryology has proved that gills are typical of vertebrates, although many vertebrates have none in the adult state. Such insight the student of embryology may gather from any animal and every organ.

The next law is, that development is always gradual—to it there are no exceptions. Even the sudden metamorphoses, *e. g.*,

[1] E. Ray Lankester has recently published a very interesting little volume on degeneration in the Nature Series.

of caterpillars, are only apparent not real exceptions, for in the caterpillar the chrysalis is gradually formed, and when perfected is merely uncovered by the casting off of the caterpillar skin, which masked the changes going on within, and so also the opaque crust of the chrysalis conceals the butterfly being formed underneath. In some animals, however, the *visible* changes though still gradual are more rapid at one time than another, as when the larval starfish (Brachiolaria) passes in a few hours into the adult form. The explanation of the gradualness of development in the Metazoa, is the dependence of the process on alterations in the single cells, and as these are small and change slowly, the whole effect is produced imperceptibly; we notice only that the embryo has advanced since we examined it before, we cannot see it advancing.

Now, the construction of an animal out of the cells derived from the impregnated egg, depends on two things; *first*, the arrangement of the cells in relation to each other; *second*, alterations in the characters of the cells themselves. We have already seen that in the course of segmentation the cells become arranged in two layers, the *ectoderm* and *entoderm*, both consisting of a single stratum of cells, and later there is a set of cells, the *mesoderm*, in between, Fig. 20. Compare also Fig. 15, p. 248.

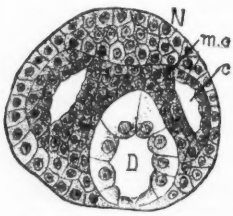

FIG. 20.—Transverse section through the head of embryo *Lumbricus trapezoides*. After Kleinenberg.

Before proceeding further it is desirable to say a few words about the middle germinal layer. Concerning its origin we have but little satisfactory information. In the lower animals (Radiates) it arises from cells which break away from the two primitive layers. In the jelly fishes it hardly exists as a distinct part, but as the Brothers Hertwig have shown, is rather an incompletely separated portion of the ectoderm. In the Bilateralia, or all animals except sponges and radiates, the mesoderm is always present as a distinct layer, which is formed *after* both the ectoderm and entoderm. Its exact origin has never been definitely settled, although the question has been interminably discussed, especially as regards vertebrates. It is, however, known that in some forms there are two special cells, one at each side of the primitive mouth of the gastrula, distinguished by their large size and containing a

large amount of nutritive matter. These cells are called the *mesoblasts*, and break up into smaller cells which form the middle germinal layer, Fig. 21. The cut represents a longitudinal section through the *double* embryo of *Lumbricus trapezoides*, after Kleinenberg. In this species the development is unique, for each egg normally grows into two individuals. The separation begins during segmentation. The two embryos are united by a cord of large cells, Fig. 21 *u*, and have at first a common mouth. In the right hand embryo of the figure, the large mesoblast lies between the inner and outer layers, and has already given rise to a number of cells, *mes*, the beginning of the mesoderm. In other cases it has been said that the mesoderm arises from the ectoderm or the entoderm, but nearly every observer is contradicted by some other, therefore it would be unprofitable for us to pursue the matter further. Suffice it to say that the embryonic mesoderm of the Bilateralia consists of a *mass* of cells, or of *several strata* when the mass is compact, whereas the other two layers are each but one cell thick. This difference is always preserved, except in the ectoderm of vertebrates, to which we shall recur. This is our third law.

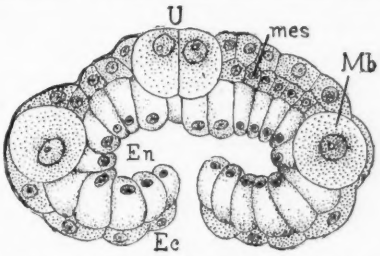

FIG. 21.—Double embryo of *Lumbricus trapezoides*, longitudinal section. After Kleinenberg.

The fourth law is that the cells are grouped in definite relations to certain ideal axes or planes. The first of these axes is the *gastrula* or *dorso-ventral;* it alone is clearly indicated in the Cœlenterata. It is the line which passes through the mouth of the gastrula and the opposite end of the body, Fig. 22 *A*.

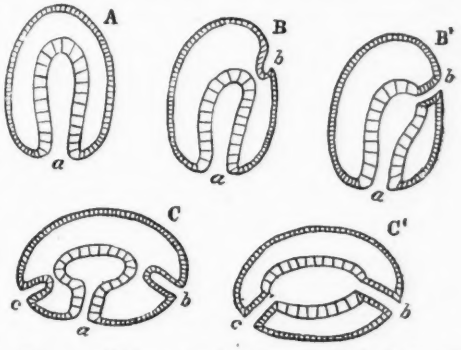

FIG. 22.—Diagrams to show the axes of the body: *A*, with mid gut alone; *B*, with fore gut: *C*, with fore gut and hind gut; *a*, opening of gastrula; *b*, of fore gut; *c*, of hind gut.

In order to understand the relation of the other axes, we must consider briefly the development of the digestive canal in the Echinoderms, and some bilateral animals. The diagrams in Fig. 22 show the points which concern us now. The ectoderm in the young Echinoderm gastrula forms a little pit, Fig. 22 *B*, *b*, near the upper end of the gastrula stomach; the bottom of this pit grows onto the wall of the stomach, an opening breaks through and the pit and the stomach form a continuous canal with two orifices, Fig. 22 *B'*. A plane passed through these two openings and through the gastrula axis will divide the body into symmetrical halves, a right and left. This plane may be called the median plane. It is of course purely ideal, not present as a structure of the embryo. In the young mollusk, a snail for instance, beside the first ectodermal pit, Fig. 22 *C*, *b*, there is formed a second one, and always in such a position that the median plane passes through it, while the gastrula mouth lies between the two involutions of the ectoderm. The gastrula mouth ultimately closes, the two pits become connected with the entodermal cavity, their exterior openings forming respectively the mouth and the anus. A line passed through these two secondary openings represents the longitudinal or antero-posterior axis. It must not be imagined that these axes necessarily always remain straight, for, on the contrary, they usually depart somewhat from the simple form, sometimes very much so, as in the case of the spirally twisted snails. These axes mark the distinction of dorsal and ventral surface, of right and left sides, of anterior and posterior ends or head and tail. In the vertebrates the axes are further complicated in a manner which will be studied in a special article, and is therefore passed over here.

The fifth law is that, however much the weight of an animal increases during its development, the ratio of the free surfaces to the mass alter but slightly from the ratio established when the embryo begins to take food from outside. It is only for convenience that I express this law in this precise form—in reality, about it our knowledge is scanty and our conceptions vague. According to a geometrical principle, when the bulk of a body bounded by a simple surface increases, the surface enlarges less than the mass —in the simplest case of a cube, the surface increases as the square, the mass as the cube of the diameter. If in a cube of unit diameter, one unit of surface bounds one unit of mass, then

in a cube of three units diameter, *nine* units of surface will bound *twenty-seven* units of mass; the proportion in the first cube is 1 : 1, in the second 1 : 3. To maintain the proper proportion in the embryo, simple enlargement is insufficient, therefore the surface becomes more and more irregular or uneven, being thereby multiplied to correspond with the bulk. The irregularities present distinctive peculiarities characteristic of each organ and part, and may be either large or microscopic. They may be conveniently classified under five heads: 1. Projections, either large like the limbs of insects and quadrupeds, the tentacles of Cœlenterates, the branchia of Amphibia, etc., or microscopic like the *villi* of the intestine.[1] 2. *Dilatations* of the digestive canal and other internal cavities; the stomach is usually a dilation. 3. *Diverticula*, or blind pouches, pushing out from one part or another; the lungs of vertebrates, for example, are diverticula of the digestive tract. 4. *Folds*, or ridges either longitudinal or transverse. A capital illustration is afforded by the common grasshopper (Caloptenus); this insect has six large diverticula springing from the front end of its stomach, each of which is traversed by twelve longitudinal folds, admirably shown in transverse sections, Fig. 23. 4. Small pits, or *invaginations*, which form glands. They differ from diverticula by their smaller size, and also in that they grow *into* the mesoderm, while the diverticula push the mesoderm along with them. A section through a couple of such pits is shown in Fig. 24, which represents "mucous glands" from the stomach of a kangaroo. It will be noticed that the cells at the bottom of the pit are larger than those nearer its mouth, so that the lower *glandular portion* is already marked off from the upper part or *duct*. Of *pits*, or *glands* as they are prop-

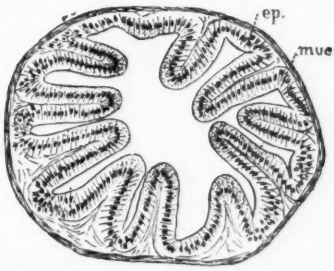

FIG. 23.—Transverse section of gastric cœcum of *Caloptenus spretus; ep*, entodermal epithelium; *muc*, muscles; *conn*, connective tissue. × about 40 diam.

[1] To see the *villi*, of which students usually have a very imperfect conception, it is only necessary to take a short piece of small intestine of a common mammal (dog or rat), slit it lengthwise, spread it out, wash it and examine with a lens. Although the inner surface of the intestine would be very small if it were smooth, yet in reality it is very great, being increased by the countless villi and glands.

erly called, there are many kinds, varying in shape and in the character of the cells lining them. They may be straight or very much elongated and coiled or twisted; they branch in many different ways, but all forms are modifications derived from simple pit-like invaginations.

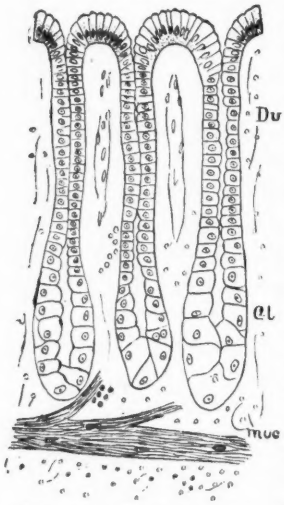

FIG. 24. — Vertical section of mucous glands from the stomach of *Macropus giganteus*. After Schaefer. × 210 diam.

The necessity of proportioning the surface to the mass arises from the fact that it is only through the surface that food, water and oxygen can be taken in, refuse matters (excretions) ejected, and sensations from the outside received. Hence when the right relation is once established it must be permanently kept up. In the growing embryo the object is so to expand the surface that as the bulk increases, the surface is always sufficient not only to supply the cells composing it, but also the inner and deeper lying tissues.

We can now understand why eggs with very little yolk are hatched very early, to become self-dependent larvæ—it is because of their small bulk, which enables a simple surface to answer their physiological needs, to digest and breathe enough. Bulkier eggs must reach a more advanced development, living the while on their own yolk, before they can lead a free life. Let it not be thought, however, that any one has ever determined, even in a single case, the proportion between the surface and the mass. There are reasons for thinking that the proportion varies considerably in different species, and even in individuals of the same species.

The sixth law is, that in all but the lowest metazoa, there are several systems of cavities formed in the mesoderm. The mesoderm becomes more important and voluminous as we ascend the animal series, and so also do the cavities of the middle layer become more complex. In many animals there is one large space known as the body cavity, but the other spaces are for the most part small; such are the organs of the circulation, the blood ves-

sels, and in vertebrates the lymphatic system. Another set of cavities forms the excretory system—the water vessels (of certain worms), the segmental organs and kidneys, all distinguished by being connected directly with the exterior by openings through the ectoderm. There are also tubular ducts which compose the secondary genital apparatus, and are, in many of the higher invertebrates and in all vertebrates, intimately connected with the excretory organs. Formerly it was supposed that the branching respiratory tubes or *trachcæ* of insects, were mesodermic, but more recent investigations tend to show that they are always invaginations of the ectoderm. All these cavities are lined each by a layer of cells, one row deep, an *epithelium*. In the circulatory channels and body-cavity, the epithelium appears to be invariably composed of broad, irregularly polygonal very thin cells, being a so-called pavement epithelium, while in the excretory tubes and genital ducts the epithelium is quite thick, each cell being at least as high as it is broad.[1]

The seventh law is of the utmost importance—each germinal layer forms predetermined special tissues, and no others, and each tissue in a predetermined position. In all bilateral animals at least, the mesoderm forms, besides the organs belonging to it exclusively, such as the heart, etc., layers of tissue around the whole entoderm and ectoderm; for example, the intestine of an adult animal is composed of an entodermal lining (epithelium) and several mesodermic coats (connective tissue and muscles); the skin is composed of an outside *epidermis*,[2] derived from the ectoderm, and under it the *dermis*, or cutis, derived from the mesoderm. An organ is said to be ectodermal or entodermal when the part essential to its physiological function arises from one or the other of the primitive layers; for example, the eye is ectodermal because its light perceiving portion is developed from the outer germ layer; the liver on the other hand is entodermal because its secreting cells are formed from the inner germ layer.

The anatomy of adult forms does not by any means always reveal to which layer a given organ properly belongs. This is perhaps better illustrated by the nervous system than by any

[1] There are certain exceptions, *e. g.*, the malpighian bodies of the vertebrate kidneys are lined by a pavement epithelium although they form part of the excretory system of cavities.

[2] Often called *hypodermis* by many writers on Invertebrates, especially by entomologists.

other structure. In nearly all animals the central nervous system (nerve ganglia, spinal cord, etc.) lies quite deep, well separated from the ectoderm or skin, yet in the embryo the nervous system arises from the ectoderm (Fig. 25, *cf.* also Fig. 20) appearing at first as cells very much like the rest of the ectoderm. They soon, however, separate from their first neighbors, moving inwards; the mesoderm then grows in between the half developed nervous cells and the ectoderm, so that they are completely divided.

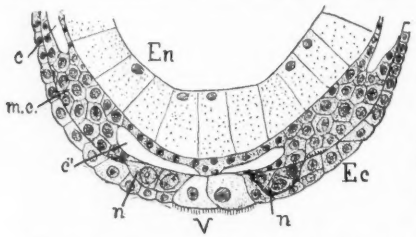

FIG. 25—Transverse section of embryo *Lumbricus trapezoides*. After Kleinenberg. *En*, entoderm; *Ec*, ectoderm; *n*, *n*, beginning of nervous system; *v*, ciliated band separating the two parts of the nervous system; *c*, *c'*, parts of body cavity; *m.c.*, mesoderm. Only the ventral half of the section is figured.

The following table shows to which of the germ layers the principal organs belong:

ECTODERM.

1. Epidermis or external skin.
   The crust of arthropods.
   Shell of mollusks.
   Horns, hairs and nails.
   Cutaneous glands.
   Cilia of larva, etc.
2. Nervous system.
   Organs of, *a* Touch.
   b Taste.
   c Smell.
   d Hearing.
   e Sight, etc.
4. Fore gut.
5. Hind gut.
6. Mouth gut (vertebrates).
7. Gills.
8. Tracheæ of insects.

MESODERM.

1. Wandering cells.
2. Connective tissue, fat cells, etc.
3. Internal skeleton.
4. Muscles.
5. Genital products.
6. Blood.
7. Organs of circulation.
8. Organs of excretion.
9. Secondary genital organs.
10. Lymphatics (and spleen).

ENTODERM.

1. Middle gut.
2. Liver.
3. Lungs.
4. Glands.
   Thyroid, pancreas, etc.
5. Various appendages of the digestive canal.

As appears from this table the destiny of each germ layer is predetermined.

The eighth law is, that the simple cells formed during segmentation change their character during embryonic growth, not only appearing differently but altering also their activity from general

to special functions. Of course it is not possible to consider here in detail the laws of histological differentiation, the more as they have never received much attention, for although hundreds of published researches elaborately describe the changes in special cases, yet the general laws of the progressive development of cells have never been seriously discussed, and rarely subject to more than incidental treatment. I shall mention only three general principles, which are at once universally applicable and readily understood. 1. Structural modifications of epitheliums usually affect similarly a whole cluster of cells; or 2. Less frequently isolated cells only. 3. The mesodermic tissues are for the most part in masses (muscles, tendons, fat, etc.) not in layers, excepting always the epithelial lining of the mesodermic cavities.

We have already considered one illustration of the first principle, the formation of the central nervous system (Fig. 25, *n*, *n*). Other areas are transformed into the retinæ, the finger nails, etc. Again smaller clusters into the lining of glands. Let us consider for a moment the peptic glands of the mammalian stomach, which are modifications of the simpler mucous glands (Fig. 24). The peptic gland is still a straight tubular pit running down from the inner surface of the stomach, but the cells composing its walls are of several kinds—one sort in the neck, *a*, two in the glandular portions, *b* and *c*, of which the darker and more closely granulate cells ("*Belegzellen*") predominate in *b*, but the lighter central cells, *h* ("*Hauptzellen*"), in *c*. The central cavity of the gland is not shown in *b* and *c*. The relative positions of the two kinds of cells will perhaps be better understood by a transverse section, Fig. 27, through the lower part, Fig. 26 *c*, of a cluster of glands, such a section being of course parallel to the inner surface of the stomach. We here have an excellent illustration of what is meant by histological differentiation, for the general arrangement of the cells is the same as in Fig. 24, but in different parts of the more complex peptic gland they have assumed distinct forms and functions.

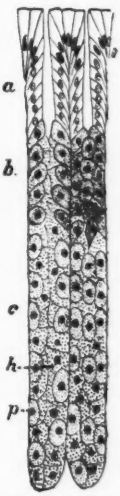

FIG. 26.—Peptic glands from stomach of guinea pig; *a*, neck; *b*, middle portion; *c*, basal glandular parts; *h*, "hauptzellen;" *p*, peripheral cells. After Rollet. × 160 diam.

The differentiation of isolated cells is often very important. In

the skin of many animals there are unicellular glands. Every minute scale making the microscopic dust on a butterfly's wing results from the modification of a single cell, from which the scale grows out; again in the ectoderm of Cœlenterates, Fig. 28, we usually find scattered among the unmodified epidermal cells single nettle cells (thread or lasso cells), *l*, and unicellular glands. The nettle cells may be readily recognized by the coiled thread in each of them; the gland cells by a small pore and their mass of secretion, Fig. 28 *D*.

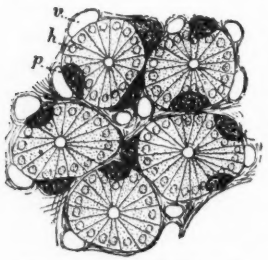

FIG. 27.—Transverse section across five peptic glands of a domestic pig; *v*, blood vessel; *h*, "hauptzellen;" *p*, peripheral cells. After Rollet. × 320 diam.

Such are the leading principles of embryology as far as our space permits dealing with them, varying however in their exact application from group to group. In all the embryos of each natural group, we can recognize peculiarities common to all the members of the group, peculiarities which we therefore designate as typical. When, however, the embryonic form leads a free life, it may often present special adaptations that change it so much as to obscure the typical features, hence in the study of those forms which begin their free life in an embryonic condition, we have to compare the larvæ, one with another, in order, by the elimination of those features which are only special and secondary, to discover the really typical structure. This is particularly the case with marine animals, whose larvæ often have bizarre shapes, which have arisen, it is to be assumed, by natural selection among the larvæ, and relate to their presentation rather than directly to their development. Therefore we shall not pause to consider the forms of embryonic larvæ. I hope, however, to publish, before long, figures which will enable the student to recognize the more common marine embryos.

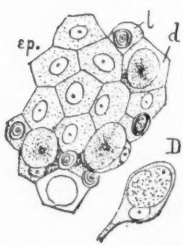

FIG. 28.—Ectoderm of Tetrapteron; *ep*, modified epidermis; *l*, lasso or nettle cell; *d*, gland cell. *D*, side view of gland cell. After Claus.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The metric system is extensively used in this country, but not yet so generally as would seem to be desirable. While its introduction into scientific work is quite general, its use in mechanics and manufactures makes slow progress. This is natural, but we believe that the merits of the system will become so obvious as ultimately to command the support of all who use measures of any kind. It is evident that such a radical change can only be made slowly, and be introduced under special circumstances, as, for instance, in the commencement of new manufacturing or engineering enterprises. Old institutions with extensive apparatus, would be involved in expense in changing their scales, and in difficulty in instructing their employés. But we cannot on this account endorse the opposition which has been displayed in some quarters. The fact that it may cost a given firm of manufacturing machinists so many thousand dollars to alter their measuring tools, does not justify those persons in resisting the general introduction of the system. The objection now most dwelt on, that the metre is not exactly what it professes to be, has, in our judgment, little bearing on the present state of the case. What the world wants, and sooner or later will have, is a uniform decimal system of weights and measures. This it has in the metric system, and its adoption has now proceeded so far that it is useless to think of proposing or creating another to take its place.

We hope that the time is near at hand when a uniform decimal system of coinage will be adopted by civilized governments. It will be much more readily introduced into common use than the changes contemplated by the metric system.

—— It has been demonstrated beyond all doubt that the Permanent Exhibition of Philadelphia can pay its running expenses. Even in its present inchoate condition it supplies a need, and is popular with a large class of citizens. But it remains to put into execution the classified museum scheme which was adopted two years ago, and before this is done provision must be made for necessary repairs to the roof and floor of the building. The former requires attention, but the condition of the floor is more serious. It is to be hoped that the subscription now on foot in

this city to raise a fund to secure these repairs, will be successful. Then it will be seen whether the Board of Directors will rise to the importance of the work cut out by the Council of Education, and will really grant to that body the privilege of carrying out the programme they have presented. Unless this is fully and frankly done, the Board of Directors may rest assured that their labors, which have been neither few nor light, will have been wasted, and that the Exposition will be a failure. The Council of Education is composed of capable men, and such as will not be found to repeat their past work unless their relations to the Exposition are placed on a permanent and satisfactory basis.

——:o:——

RECENT LITERATURE.

THE TARSUS AND CARPUS OF BIRDS.[1]—In his first paper, Prof. Morse gives the results of his examination of the embryos of various North American birds, with reference to the primitive constitution of their tarsus and carpus. In the former he finds three bones, *tibiale*, *fibulare* and *centrale*. The first two unite into an hourglass-shaped bone such as exists among Dinosauria, the *astragalo-calcaneum*, while the last forms the cap for the metatarsals, contributing to the adult tarsometatarse. In the carpus Prof. Morse finds four bones (rarely five), of which two become united with the ulno-radius, and two or three with the metacarpals. He then introduces the description of a fourth tarsal bone found by Prof. Wyman in the "blue heron," and mentioned by him in a letter. Prof. Morse concludes that this element is the intermedium of Gegenbaur somewhat out of place. In his quarto memoir, the author further investigates this fourth tarsal and its homologues. His studies having been directed to the lower birds, as penguins, auks, petrels, etc., he finds the ascending bone partly occupying the position of the intermedium in several of them. He finds that it early unites with the tibiale and fibulare, forming a temporary *astragalo-calcaneum*, which thereafter unites with the tibia. He is thus able to homologize the ascending process of the *astragalo-calcaneum* of *Ornithotarsus* and *Lælaps* with the intermedium. In the course of his examinations of the manus of the sea pigeon, Prof. Morse found curious apical expansions of the distal phalanges.

We have been much interested in this essay, and commend it as a good illustration of the meaning of the term *monograph*.

[1] *The Tarsus and Carpus of Birds.* By E. S. MORSE, Ph.D. Annals Lyceum New York, 1872.

The Identity of the Ascending Process of the Astragalus in Birds with the Intermedium. By E. S. MORSE, Ph.D. Anniv. Mem. Boston Soc. N. History. 1880. 4to.

A MANUAL OF THE INFUSORIA.[1]—The first installment of 144 pages of this work impresses us with the belief that the English reading student who desires to become acquainted with the remarkable animals of which it treats, should take early measures to secure a copy. The execution of the work, both as to illustrations and text, is excellent, while its size is convenient for actual students. The author introduces us to the objects of his studies in a highly agreeable manner, rendering even the details of the history of their successive discovery interesting. The scientific results are important, including some systematic views which will at least aid in the analysis of the forms included in the class. Thirteen divisions are recognized which fall into four orders, viz: the *Pantostomata*, *Discostomata*, *Eustomata* and *Polystomata*.

Mr. Kent devotes a chapter to spontaneous generation, and we make some extracts treating of this obscure and interesting subject.

"The general conclusions deducible from the long array of evidence now produced with respect to the question of 'spontaneous generation,' or 'abiogenesis,' may now be briefly summarized. From every line of inquiry investigated, one and the same answer is invariably returned. Life in its most humble and obscure form, be it existent as impalpable germinal dust floating in the atmosphere, or shaken from a truss of hay, or manifested in its more active state as the minute monads, bacteria and other organisms developed in infusions, tells everywhere the same unvarying tale. Traced backwards to its origin, or forwards to its ultimate development, each type is found by patient search to be derived, not *de novo* out of dead or inorganic elements, but from a specific parental form identical in all respects with itself, and whose life-cycle is as true and complete as that, even, of man himself. * * *

"In order to arrive at a comprehensive insight into the life phenomena and progressive developmental manifestations of the special group of infusorial animalcules now under consideration, hay from different localities was placed in maceration and examined continuously, from its first contact with the fluid medium, for periods varying in duration from a few days only to several weeks. The water added to the hay was of the purest possible description, and was frequently boiled for some time to prevent the introduction of extraneous germs. In all instances the results obtained were broadly and fundamentally the same, and differed only with respect to the specific types found living together in the separate infusions. Even here, however, the general dominance of two or more special forms was notably apparent. Commencing with the first wetting and simultaneous examination of any given

[1] *A Manual of the Infusoria*; including a description of all known Flagellate, Ciliate and Tentaculiferous Protozoa. By W. SAVILLE KENT, F.L.S. Roy. 8vo. London, David Boyne, 1880.

sample, spores of different sizes were found congregated in countless numbers and in various orders of distribution throughout the surfaces of the vegetable tissues. The majority of these spores were excessively minute, spherical, of the average diameter of the 1–20,000th part of an English inch, and required necessarily the employment of the highest powers of the compound microscope for the correct registration of their characteristic form and size. Sometimes these spores were to be observed collected in definite spherical heaps, but more often they were scattered in irregular-shaped patches, such patches being often again more or less confluent, and thus forming collections of considerable extent. A large number of these spores were likewise to be seen, detached from their original adhesions, freely floating in the water or collected in masses upon the peripheries of the small air bubbles that had here and there become entangled between the slide and covering glass. In this latter instance the spores exhibited a thicker and more opaque bounding wall, and manifested, as in the case of lycopodium powder, the power of resisting for some time the hydrostatic or wetting action of the water: this property had already been suspected by Prof. Tyndall to be possessed by these minute bodies, but had not previously been practically demonstrated.

"The hay within from four to six hours after maceration revealed on examination of a small fragment, a considerable alteration in the character and comportment of the associated spores. Hitherto these had displayed no signs of motion, a uniform stillness reigning throughout the entire expanse of the microscopic field. Now, however, among the numbers that had become detached from their original adhesion to the vegetable matter, the majority exhibited an active vibratory motion that at first sight was scarcely to be distinguished from the characteristic 'Brownian movements.' The size of these motile spores corresponded with that of the quiescent ones, not exceeding the 1–20,000th of an inch in diameter, and without recourse to the highest magnifying power and the most careful adjustment of the illumination, it was not found possible to ascertain by what means their locomotion was accomplished. Examined successively with the $\frac{1}{16}$, $\frac{1}{25}$ and $\frac{1}{50}$ inch objectives of Messrs. Powell and Lealand, it was at length satisfactorily determined that each individual spore or body was furnished with a single, long, slender, whip-like organ or flagellum, whose active vibrations propelled the spherical body through the water. These minute motile corpuscles exhibited, in fact, at this early stage of their development a type of organization in all ways comparable with that of the simply uniflagellate genus Monas."

PACKARD'S ZOOLOGY, SECOND EDITION.[1]—In revising this text

[1] *Zoology for High Schools and Colleges.* By A. S. PACKARD, Jr. Second edition, revised. New York, Henry Holt & Co., 1880. 12mo, pp. 719. $3.00.

book, the author has availed himself of the criticisms of other naturalists, and thus made a considerable number of changes in the stereotype plates. Several of the figures, notably that illustrating the anatomy of the cat, have been changed, and one of the opossum and its marsupial bone added. Other changes have been made in order to bring the book up to the present state of the science.

DAUBREE'S CHEMICAL GEOLOGY.[1]—This grand work may be regarded as a revised collected edition of the former smaller papers of M. Daubrée on experimental geology. It may be regarded as the great work of M. Daubrée's most laborious and successful scientific life, and on it he may safely rest his fame.

The first section of the work deals with chemical and physical phenomena—metalliferous deposits, nature of metamorphism, the effect of heated waters, formation of zeolites, amygdaloids, rocks both eruptive and metamorphic, and volcanic action.

The second section treats of mechanical phenomena, and applies the rigid experimental method of trituration and transportation of sediments, and chemical decompositions by mechanical forces; the distribution of gold in the bed of the Rhine is also discussed. The first chapter contains an account of the experiments on the striation of rocks. The marks or striæ are produced or imitated by rubbing pebbles together. The second chapter treats of the deformations which the earth's crust has been subjected to in former ways. Sir James Hall's experiments were of a similar character. The remarkable examples of reversed folds, as shown in the Alpine regions, are imitated and explained. The discussion of the nature and causes of faults, joints and all kinds of fractures in sedimentary rocks will be read by the geologist with peculiar interest. The account of the experiments on the heat developed by the crushing, grinding and mutual frictions of rocks are important; it is believed that sufficient heat may be generated in this way to produce metamorphism.

The second part treats altogether of cosmic bodies. Three hundred and fifty pages are devoted to the experimental study of the structure and genesis of meteorites and the accompanying minerals. The entire volume is well illustrated, and as a specimen of typography may be regarded as a model of clearness and beauty.—*F. V. H.*

HERTWIG'S CHÆTOGNATH WORMS.[2]—A careful elaboration of the morphology and development of the Sagittà, the type of the Chætognathi, that singular type of worms, so aberrant that it has

[1] *Etudes Synthetiques de Geologie Experimentale.* Par A. Daubrée. Premiere partie—Application de la méthode experimentale a l'etude de divers phenoménes geologiques. Deuxieme partie—Application de la méthode experimentale a l'etude de divers phenoménes cosmologiques. Large 8vo, 828 pages.

[2] *Die Chætognathen. Ihre Anatomie, Systematik und Entwicklungsgeschichte.* Eine Monographie. Von Dr. OSCAR HERTWIG. Mit 6 Tafeln. Jena, 1880. 8vo, pp. 112.

by different authors been regarded as a vertebrate, a mollusk, as well as a crustacean, has been greatly needed. Dr. Oscar Hertwig is so excellent a histologist and anatomist, that we may feel sure that this investigation has been made with the same exactitude which has characterized his previous labors on the lower animals. Our knowledge of Sagitta had already been greatly extended by the researches of Krohn and Kowalevsky, and owing to the results reached by them, no one now doubts but that Sagitta is a worm (Vermes), though its place among the classes of Vermes is uncertain. Hertwig concludes that it agrees best with the Nematodes and Annelides.

WADSWORTH'S GEOLOGICAL PAPERS.[1]—These papers by Prof. Wadsworth are, like all the preceding writings of this author, of the most thorough character. He has made the microscopic study of igneous and metamorphic rocks a special study for several years, and by his thoroughness has elevated this department of geology very nearly to an exact science. The first paper, on the geology of Lake Superior, is the most important one, and contains six effective octavo plates, showing the relations of the different kinds of rocks to each other; the dykes, bands of iron ores, jasper veins, felsites, diorites are clearly shown in their relations to each other in the rock masses. Mr. Wadsworth has not relied on the microscope alone, but has given many important chemical analyses of minerals. The historical account of the explorations of others in that region, with the bibliography at the end of the memoirs, is very valuable. We wish we could quote largely from these papers, but space will not permit.—*F. V. H.*

PHYSICAL AND GEOLOGICAL RESULTS OF THE FRENCH EXPEDITION TO OBSERVE THE TRANSIT OF VENUS.[2]—These beautiful volumes are a portion of the results of the French Expedition to observe the Transit of Venus. The first part deals with the physical results of the expedition, printed in fine clear type with eighteen excellent plates, a portion of them photographic. The

[1] *Notes on the Geology of the Iron and Copper Districts of Lake Superior.* By M. E. Wadsworth. Bulletin of the Museum of Comparative Zoölogy at Harvard College, Whole Series, Vol. VII. (Geological Series, Vol. I). pp. 157, with 6 plates.

On the Elongation and Plasticity of Pebbles in Conglomerates. By M. E. WADSWORTH. (From the Proceedings of the Boston Society of Natural History, Vol. XX, Nov. 5, 1879.)

Danalite from the Iron Mine, Bartlett, New Hampshire. By M. E. WADSWORTH.

Picrolite from a Serpentine Quarry in Florida, Mass. By M. E. WADSWORTH.

[2] *Mission de l'Isle Saint-Paul Observations Astronomiques, operations photographiques, observations magnetiques et hydrographie.* Institut de France. Academie des Sciences. Recueil de memoires a l'observation du passage de Vénus sur le Soleil. (Extrait du tome II, 1st partie.) 425 pp., 4to, 18 plates and maps.

Recherches Geologiques faites, a Aden, a la Reunion, aux Isles Saint Paul et Amsterdam, aux Seychelles. Par M. CH. VELAIN, Maitre de conferences a la Sorbonne. 460 pp., 4to, 25 plates and maps. (Extrait du tome II, 2d partie.) Paris, 1879.

engravings are good, showing with great detail the surface features of the island, pictorially and topographically. But to the naturalist and geologist, the second part, by M. Velain, is of greater interest. This volume is illustrated with twenty-seven quarto plates, eight of which are by the photoglyptic process, and are microscopic studies of the volcanic rocks. The island itself is of volcanic origin, and entirely composed of igneous rocks. This volume is a most elaborate monograph of the mineralogical and structural history of the island, by means of sections and colored maps, and it certainly is a model of careful study and bookmaking. Many actual volcanoes are shown to exist on the island, in operation at the present time. The publication of these important volumes is very creditable to the Government of France as well as to the authors.

M. Velain has recently published a small brochure of great interest in Bulletin No. 7 of the Mineralogical Society of France, on the microscopic study of the glass or slag resulting from the fusion of the ashes of grasses. It is illustrated with an excellent octavo plate showing the production, artificially, of the crystals of tridymite, anorthcite, wollastonite and augite.—*F. V. H.*

Sigsbee's Deep Sea Sounding and Dredging.[1]—It is greatly to the credit of American science and to our government, that it has taken so prominent a part in deep sea explorations. This is due largely to the labors and energy of the lamented Count Pourtales, who was a distinguished physical geographer and for a long time an assistant in the U. S. Coast Survey. He was the first to show that the warmer waters of the tropics, notably the Floridan seas, with their profusion of tropical life, were underlaid by a colder bottom stratum of water with a nearly equal profusion of what was hitherto supposed to be purely Arctic life. The Norwegian marine zoölogists had previously demonstrated the existence of a deep-sea fauna off the coast of Norway, and the Swedish naturalist, Lovén, had suggested that this deep sea fauna was widespread over the ocean bottom, but Pourtales demonstrated it, and the subsequent deep sea explorations of the English Navy, especially the Challenger Expedition, carried out and extended Pourtales' discoveries.

Pourtales was aided and advised by his friend Agassiz, and the work of exploration of the ocean bottom under the Gulf Stream off the Floridan peninsula, and in the Gulf of Mexico, as well as off the southern coast of the United States, has of late years been extended by the officers of the U. S. Coast Survey, Mr. Alexander Agassiz being the naturalist of the recent expeditions. The Coast Survey has now a beautiful steamer, the *Blake*, of 350 tons,

[1] *United States Coast and Geodetic Survey.* Carlisle P. Patterson, Superintendent. Deep sea Sounding and Dredging. A description and discussion of the methods and appliances used on board the Coast and Geodetic Survey Steamer *Blake*. By Charles D. Sigsbee, U.S.N. Washington, D. C., 1880. 4to, pp. 192.

built and equipped for the work of deep sea sounding and dredging. The successive officers, Commanders Howell, Sigsbee and Bartlett, especially Commander Sigsbee, have devised the most elaborate and effective machinery for this difficult work, and the present elegant volume gives in great detail the methods and instruments for studying the physics of the sea and for investigating the life of the ocean from the surface to the bottom, even to the abyssal depths; subjects bearing intimately on the physics, geology and biology of the globe. The Superintendent of the Coast Survey, after giving in a prefatory note the history of these undertakings, refers with pride to the fact "that in the small steamer *Blake*, of only 350 tons burthen, n. m., under the energetic and skillful commands of Lieut. Com. Sigsbee and Com. Bartlett, with a full complement of forty-five, including officers and crew, more rapid work was done than had been accomplished with the old methods and appliances by the *Challenger*, a vessel of over 2000 tons burthen, with a complement of twenty-nine naval and civil officers and a correspondingly large crew."

RECENT BOOKS AND PAMPHLETS.—History of North American Pinnipeds. By Joel A. Allen. (Dep. Int., U. S. Geol. and Geog. Surv. Terr., Misc. Pub. No. 12). pp. 785. Washington, 1880. From the author.

Annual Report of the National Academy of Sciences. pp. 22. Washington, 1880. From the academy.

Description of Four New Species and a new variety of Silurian Fossils and Remarks on others. By S. A. Miller. (From Journ. Cincinnati Soc. Nat. Hist. Oct. 1880.) pp. 5, 1 plate. From the author.

The Devonian Insects of New Brunswick. By Samuel H. Scudder. (From Anniv. Mem. Boston Soc. Nat. Hist.) 4to, pp. 41, 1 plate. Boston, 1880. From the author.

Etude sur la Faune Ichthyologique de l'Ogooue par M. H. E. Sauvage. (From Nouv. Archiv. du Museum, deuxieme série. Paris, 1880.) 4to, pp. 55, 3 plates. From the author.

Notice sur les Travaux Scientifiques de Belgrand par M. A. Delaire. 8vo, pp. 20. Paris, 1880. From the author.

Zoologie in Beziehung zur Anthropologie mit Einschluss der tertiären Säugethiere. Von Dr. W. Branco. (From Archiv. für Anthrop., for 1879 and 1880.) 4to, 1880. From the author.

Centralblatt für das gesammte Forstwesen. Heft. 5. May, 1880. 8vo, pp. 6. From the editor.

Vorläufige Mittheilung über die Entwickelungsgeschichte der Petromyzonten. Von Dr. W. B. Scott. (Ext. from Zool. Anzeiger, 1880, No. 63 u 64.) 8vo, pp. 7. From the author.

Untersuchungen über die Organization von Cycloclypeus ucarp. und Orbitoides D'Orb. Von. Dr. K. Martin. pp. 24, 2 plates. 1880. From the author.

Untersuchungen über die Organization von Astylospongia Ferd. Roem., und Bemerkungen über die Natur der Wallsteine, Meyer. Von. Dr. K. Martin, Wismar. (Aus dem Archiv. des Ver. der Freunde der Naturg. in Mecklenburg Jahrg. 31.) 8vo, pp. 32, 1 plate. Neubrandenburg, 1877. From the author.

Ichthyologische Beiträge (IX.) Von. Dr. Franz Steindachner. I. Uber eine Sammlung von Flussfischen von Tolnzona auf Madagascar. II. Uber zwei neue Agonus-arten aus Californien. III. Uber einige Fischarten aus dem nördlichen Japan, gesammelt vom Prof. Dybowski. (Aus dem LXXXII Bande der Sitzb. der k.

Akad. der Wissensch. 1. Abth. Juli-Heft. Jahrg. 1880.) pp. 29, 6 plates. From the author.

Topographical and Geological Atlas of the district of the High Plateau of Utah, to accompany Report of Capt. C. E. Dutton. (Dep. Int. U. S. Geol. and Geog. Surv. Rocky Mountain Region.) Atlas, 8 sheets. New York, 1879. From the survey.

Contributions to the anatomy of the genus Pentremites, with description of new species. By Dr. G. Hambach. (From Trans. St. Louis Acad. of Sciences). 8vo, pp. 16, 2 plates. From the author.

Etude Stratigraphique et Paléontologique des Terrains Jurassiques du Portugal par Paul Choffat. 4to, pp. 12, 72. Première Livraison. Lisbon, 1880. From the author.

Mémoire sur les Poissons Fossiles des lignites de Sieblos. T. C. Winkler, pp. 24, 2 plates.

Description de Quelque Restes de Poissons Fossiles des terrains triassiques des environs de Wirzbourg. T. C. Winkler, pp. 41, plate, 5.

Note sur Quelques Dents de Poissons Fossiles de l'oligocene inférieur et moyen du Limbourg. Par T. C. Winkler. pp. 12. (Three Extracts of the Archives de Musée Teyler, Vol. v, Livr. 2). Harlem, 1880. From the author.

Anales del Museo Nacional de México. Tome 2. 4to, pp. 57, 3 plates. From the museum.

Spolia Atlantica. Bidrag til Kundskab om Formforandringer hos Fiske under deres Vœxt og Udvikling særligt hos nogle af Atlanterhavets Hjsfiske af Dr. Chr. Lütken. (Ext. Vidensk. Selsk. Skr. 5. Række, natur. og math. Afd. XII, 6). 4to, pp. 198, 5 plates. Copenhagen, 1880. From the author.

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GENERAL NOTES.

BOTANY.[1]

THE BOTANY OF A CITY SQUARE.—Manhattan Square, in New York city, comprises a desolate and broken area of eighteen acres on the west side of Central Park, at Seventy-seventh street and Eighth avenue. It presented, a year ago, the appearance of a basin with an irregular marginal shelf of higher ground and with a ridge of gneissoid rocks running in from its south-eastern corner, upon whose summit stood the American Museum of Natural History. It was otherwise varied by artificial mounds formed of huge gneiss blocks split and blasted off from the original hill which rose up where the museum now stands, and its sides, in many places presented steep banks formed from similar fragments confusedly heaped up in precipitous and jagged piles. The lowest part of this ground was covered by a stagnant pond whose periodical putrescence became both offensive and dangerous. With the bare shoulders of rock protruding in naked bosses here and there, the general aspect of the square was particularly forlorn and unfortunate. The complaint of the health officers in conjunction with a revival of the original intentions to make this spot an appropriate outlier of Central Park, both healthy and attractive, resulted in some municipal efforts to secure these ends. Earth was carted in, the sightless slopes of stone were covered over, the pond filled up, the bare tables of rock hidden, and an attempt made to change the abrupt and angular outlines into

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

smooth and graceful contours. Whether the results secured were at all proportionate to the time and money expended, is one of those public problems whose solution is best referred to the professional politician. Certainly one result, not aimed at, was to introduce into the square an army of plants whose luxuriant and rapid growth soon covered it with a mantle of waving weeds. Curious to ascertain how many plants flourished upon this limited and forbidding area, the author, at such times as he was at liberty to collect them, began a systematic search over it, and although conscious that want of time interfered with its completeness, yet its extent has caused some surprise, and may prove of interest to a wider circle of students and collectors.

It may be premised for the information of those to whom Manhattan Square, in New York city, is a *terra incognita*, that the immediate district about it is a representative purlieu of a great city, where clusters of shanties alternate with half-finished blocks of handsome houses or stores, the whole a transition phase to a larger and denser population. Not twenty blocks away the closely built up blocks of the city are seen, and Manhattan Square itself may soon be surrounded by sandstone and marble dwellings, and every trace of vegetable existence, except such as shall distinguish or decorate it, be exterminated. The semi-alluvial bottoms of some of the pit-like depressions, and the fertile blanket of soil lying over the low swells of rock in the neighborhood, have been appropriated by squatters for kitchen gardens, and assume in summer an almost rural aspect. The following is a catalogue of the plants collected in Manhattan Square, New York city, in the summer of 1880:

Ranunculaceæ.

Ranunculus acris.

Cruciferæ.

Sisymbrium officinale,
" canescens,
Brassica nigra,
Capsella bursa-pastoris,
Lepidium virginicum.

Hypericaceæ.

Hypericum perforatum.

Caryophyllaceæ.

Silene inflata (A. Woodward) 1 specimen,
" noctiflora, one specimen.
Stellaria media,
Mollugo verticillata.

Portulacaceæ.

Portulaca oleracea.

Malvaceæ.

Malva rotundifolia,
Abutilon avicennæ.

Geraniaceæ.

Geranium carolinianum,
Impatiens fulva,
Oxalis stricta.

Simarubaceæ.

Ailanthus glandulosus.

Anacardiaceæ.

Rhus glabra,
Rhus toxicodendron.

Vitaceæ.

Ampelopsis quinquefolia.

Leguminosæ.

Trifolium agrarium,
" pratense,
" repens,
Melilotus alba,
Apios tuberosa.

Rosaceæ.

Potentilla argentea,
" canadensis,
Fragaria vesca,
Rubus canadensis,
" villosus.

Crassulaceæ.

Penthorum sedoides.

Onagraceæ.

Epilobium palustre, var. lineare,
Œnothera biennis.

Umbelliferæ.

Daucus carota.

Caprifoliaceæ.

Sambucus canadensis.

Compositæ.

Vernonia noveboracensis,
Eupatorium perfoliatum,
Aster simplex,
" novæ angliæ,
" ericoides,
" tradescanti,
" multiflorus,
" acuminatus,
Erigeron canadense,
Solidago canadensis,
" nemoralis,
" tenuifolia,
Ambrosia artemisiæfolia,
Xanthium strumarium,
Helianthus annuus,
Bidens cernua,
Bidens frondosa,
" chrysanthemoides,
Leucanthemum vulgare,
Achillea millefolium,
Galinsoga parviflora,
Maruta cotula,
Gnaphalium decurrens,
Antennaria margaritacea,
Cirsium arvense,
" lanceolatum,
Lappa officinalis,
Cichorium intybus,
Lactuca canadensis,
" scariola,
Mulgedium acuminatum,
Taraxacum dens-leonis.

Campanulaceæ.

Campanula rapunculoides,

Plantaginaceæ.

Plantago major.

Bignoniaceæ.

Catalpa bignonioides.

Scrophulariaceæ.

Verbascum blattaria,
" thapsus,
Linaria vulgaris,
Mimulus ringens,
Veronica sp.?

Verbenaceæ.

Verbena urticifolia,
Verbena hastata.

Labiatæ.

Lycopus europæus, var. sinuatus,
Salvia lyrata, one specimen,
Collinsonia canadensis,
Nepeta glechoma,
Brunella vulgaris,
Scutellaria lateriflora,
Leonurus cardiaca.

Convolvulaceæ.

Convolvulus arvensis,
Ipomæa purpurea.

Solanaceæ.

Solanum nigrum,
Datura tatula,
Datura stramonium.

Asclepiadaceæ.

Asclepias cornuti.

Phytolaccaceæ.

Phytolacca decandra.

Chenopodiaceæ.

Chenopodium urbicum?
" ambrosioides,
" botrys,
Chenopodium album,
Atriplex patula, var. hastata.

Amarantaceæ.

Amarantus caudatus,
" albus,
Amarantus retroflexus.

Polygonaceæ.

Polygonum orientale,
" persicaria,
" hydropiper,
" acre,
" aviculare, var. erectum,
Polygonum pennsylvanicum,
" dumetorum, var scandens
" sagittatum,
Rumex crispus,
" acetosella.

Euphorbiaceæ.

Euphorbia maculata,
Acalypha virginica.

Cannabineæ.

Cannabis sativa.

Smilaceæ.

Smilax rotundifolia.

Cyperaceæ.

Cyperus strigosus.

Filices.

Aspidium spinulosum?
Onoclea sensibilis.

The great body of the recently introduced plants are made up of the Amaranths, Chenopodia, Ambrosiæ, Atriplex, Polygona, especially *P. orientale*, Erigeron, and Datura. These attained surprising proportions, and both in size and numbers resembled diminutive forests. Many of the wilder species doubtless were here previous to its present occupancy, and the water-loving plants remained in the moist precincts of the old partially obliterated pond. The Gramineæ, about five species, were omitted.—*L. P. Gratacap.*

A Dispermous Acorn.—In a collection of acorns of *Quercus prinus* Linn. var. *monticola* Michx., found near Diamond Hill quarry, R. I., I noticed one much larger than the others, which were all large, even for the species. I put these acorns in a little paper box in a drawer which I keep for such fruits. In a few days the warmth of the room caused it to germinate, when I noticed two radicles protruding. I then removed the acorn to a bit of perforated cardboard above a tumbler of water, and watched the growth. Afterwards I made a dissection and found, as I expected, two equally developed seeds, each separable into its own two cotyledons, as shown by the accompanying figures. It will be remembered that the ovary of the oak is three-celled and six-ovuled, and that in ripening only one cell remains, and this is filled by one seed. Here two have been equally developed. I find in Masters' Teratology the same thing recorded of Corylus, but nothing is said of Quercus, hence it may be well to record this instance. This phenomenon must not be confounded with poly-embryony, or multiplication of embryos in *one seed*, as in Citrus. In this case while we see an abnormality indeed, it

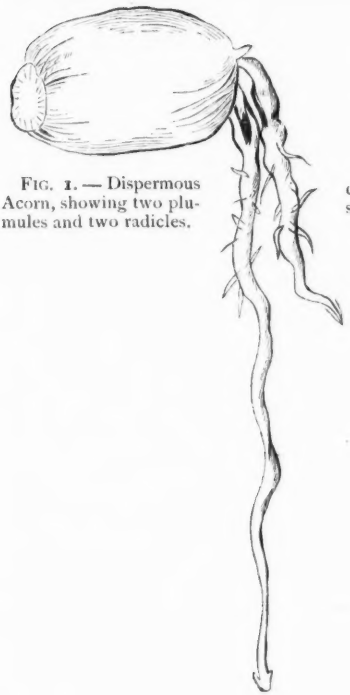

FIG. 1. — Dispermous Acorn, showing two plumules and two radicles.

FIG. 2.—Same with covering removed, showing two seeds.

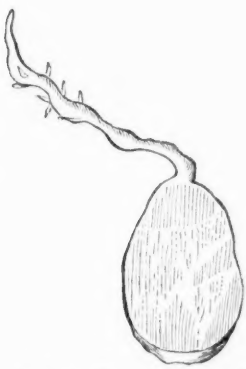

FIG. 3.—One seed removed.

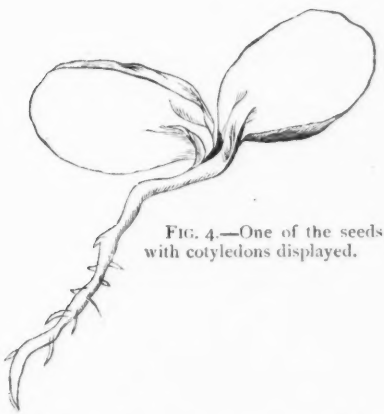

FIG. 4.—One of the seeds with cotyledons displayed.

results merely from the retention in the fruit of some of the parts seen in the ovary, but usually obliterated afterwards.—*W. W. Bailey, Providence, R. I., Oct. 15, 1880.*

BOTANICAL NOTES.—In the prospectus of the *Botanical Gazette* for 1881, the editor takes strong ground in favor of more physiological work, and "would gladly devote half of its space" to papers and notes in this department of Botany. It is to be hoped that the editor may succeed in his laudable undertaking. It certainly is high time that we have a botanical journal in this country devoted entirely to such work.——A very useful "Synoptical Table for the Determination of Fibers of Vegetable Origin" is published in the August-September number of the *Botanical Gazette*. It is from Vetellart's work, "Sur les fibres employes dans l'industrie."——In the September "Torrey Botanical Bulletin," John Williamson contributes a readable account of the "Ferns on the Cumberland." The discovery of *Adiantum capillus-veneris* in Southern Kentucky was confirmed.——A new and enlarged edition of Rattan's "Popular California Flora" has just appeared, from the house of Bancroft & Co., of San Francisco. It will prove quite valuable to the beginners in botany in central California. Many of the more difficult orders, as for example, the Coniferæ, Gramineæ, Cyperaceæ, Salicaceæ, Compositæ, etc. are entirely omitted as too hard for the beginner.——The second volume of the "Botany of California," by Sereno Watson, has just appeared. It will be noticed more fully hereafter.——In the *American Journal of Science and Arts* for October, Dr. Gray briefly notices two recent Swedish contributions to Pomology. One of these records the results of trials made of varieties of apples and other fruits, with a view to determining the northern limit of their hardiness. More than eight hundred varieties were tried, the investigation extending over a period of twelve years. Our American fruit growers would doubtless do well to acquaint themselves with these works.——The more important articles in Caruel's *Nuovo Giornale Botanico Italiano* for July, are by Jatta on the lichens of Central Italy; Macchiati, on the periodical spontaneous movements of the stamens of *Ruta bracteosa* and *Smyrnium rotundifolium* and Cugni on the germination of oily seeds. ——The "Catalogue of Pacific Coast Fungi," by Dr. Harkness and J. P. Moore, published under the direction of the California Academy of Sciences, is a most creditable one. The only other State in the country (for this catalogue is practically confined to California), whose fungi have been as fully catalogued is North Carolina, Dr. Curtis having done for his State in 1867, what the authors of the present catalogue have in 1880 done for theirs.

ZOOLOGY.[1]

THE METAMORPHOSIS OF ACTINOTROCHA.[2]—Schneider first showed that the larva (Actinotrocha) of the Gephyrean, Phoronis,

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A., Washington, D. C.

[2] Abstract of a paper read before the American Association for the Advancement of Science, in Boston, August, 1880.

passes into the adult condition through the development of a deep pouch-like invagination of the ventral body-wall which becomes attached to the stomach, and is at length suddenly evaginated, dragging out into its cavity a long U-shaped loop of the intestinal canal, and thus producing the remarkable flexure of the latter in the adult. This pouch after its evagination forms the greater part of the body; the opposite or dorsal side of the larva becomes much shortened, and is only represented in the adult by the short interval between the mouth and the anus. A study of two species of Actinotrocha occurring in Chesapeake Bay (to be elsewhere more fully described), suggests the following explanation of the significance and origin of this strange metamorphosis:

Considerations which for want of space cannot be here detailed, leave little doubt that the primitive forms among the Gephyrea are those which, like Thalassema or Bonellia, have the mouth and anus at opposite extremities of the body. Forms like Phoronis or Phascolosoma, in which these two openings are near the same extremity, are evidently derivative; in the case of Phoronis, at least, I assume this structure to have been brought about by the flexure of a primitive form into a U-shape (in order, perhaps, to void excrement through the mouth of the tube inhabited by the worm), and the subsequent obliteration of external evidences of this flexure through coalescence of the two parts of the body thus flexed. Such a habit of flexure may be actually observed among some Polychæta and Holothurians; and in the latter case several stages in the obliteration of flexure by coalescence may be observed. The Polychætous larva, Mitraria, affords a further illustration of this point.

Through whatever process we assume the peculiar flexure of the intestine to have been effected, it is clear that the pouch of Actinotrocha, *both before and after its evagination*, is a development of the *ventral* region of the body. And it follows that in the adult the ventral region is greatly in excess of the dorsal, while in the larva they are externally nearly equal. The pouch of the larva is evidently a provision to admit of extensive increase in the ventral region as a preparation for the adult structure, without changing the external form of the body, and thus without impairing the adaptation of the larva to its Pelagic life. Thus the creature is enabled to pass at once, by a single leap, as it were, from one set of conditions to an entirely different set, without having to pass through intermediate stages. Evidently a great saving of time and energy is thus effected.

The pouch is probably to be regarded as a specialization of a primitive simple infolding of the ventral body-wall. The metamorphosis is in reality a sudden and extreme flexure of the larval body, and may be considered as the ontogenetic repetition of a habit of adult ancestral forms.—*Edmund B. Wilson.*

Occurrence of the Web-fingered Sea-robin on the Coast of Maine.—I wish to place on record the occurrence on the coast of Maine of *Prionotus carolinus* (Linn.) Cuv. and Val., the web-fingered sea-robin. I have a specimen which I obtained from a fisherman who took it in a seine with other fishes off Harpswell in Casco bay, on June 26th of this year. The fisherman informs me that another specimen was obtained at the same time.

This species seems never to have been mentioned as occurring so far north before. Storer in his "History of the Fishes of Massachusetts," 1867 (Mem. Amer. Acad.), states that it occasionally occurs in Massachusetts bay. Goode and Bean in their "Catalogue of the Fishes of Essex County, Mass." (Bulletin of the Essex Institute, Vol. XI), mention specimens taken at Salem.—*L. A. Lee, Brunswick, Maine.*

The Little Striped Skunk Climbing.—It may not be uninteresting to know that one alone of the skunk family, so far as I have observed, possesses the faculty of tree climbing; the *Mephitis putorius*. This is a well established fact, as the numerous specimens captured, with one exception, all have been taken from trees, and as the species is common, only less abundant than the *Mephitis mephitica*, the climbing proclivity is too often put to the test for the animal's good. I am not aware that this habit has ever been mentioned in published works; nor do I think that it is known outside of this State.—*G. W. Marnock, Helotes, Texas.*

Voraciousness of Chordeiles popetue Baird.—While out gunning a few evenings ago, I shot a specimen of the above species, that was flying very low. Just in the dusk of evening, I was surprised to find the bird so heavy and so large. The next morning when I came to take the skin off, I found the cause of the weight and enlargement was principally due to the food the creature had taken. I took from the food sacks as many insects as I could hold in the hollow of one hand, and counted them. To my astonishment I found over six hundred. There were gnats and flies of several species, ants, small beetles and the legs of grasshoppers. I think these birds ought to be encouraged as insect exterminators.—*F. L. Harvey, Ark. Ind. Univ., Fayetteville, Ark.*

Leeches on a Turtle.—To-day I found a turtle thirteen centimeters long and seven centimeters wide, on which were two hundred and forty-nine leeches. One of these, attached to the left side of the neck, was of adult size. The others averaging about three mm. in length in the contracted state were divided in three groups. The largest situated in the fold above the right hind leg. contained one hundred and forty-three. The next above the left hind leg contained ninety-two. The last above the right fore leg contained thirteen.—*Wm. Herbert Rollins, 12 Beacon street, Boston.*

THE ORGANS OF SMELL IN INSECTS.—A recent number of Siebold and Kölliker's Zeitschrift, contains an article by G. Hauser, on the minute structure of the sense organs in the antennæ of different insects, which throws much new light on the functions of the antennæ of insects. He concludes that the organs of smell consist in insects, *i. e.*, all the Orthoptera, Pseudoneuroptera, Diptera and Hymenoptera, also in a large part of the Lepidoptera, Neuroptera and Coleoptera: 1. Of the antennal nerve; 2. Of a terminal perceptive apparatus, which consists of rod-bearing cells arising from hypodermis-cells, with which a nerve-fiber connects; 3. Of an apparatus consisting of a pit or a cone filled with a serous fluid, which are to be considered as simple infoldings and projections of the epidermis. He then discusses the mode of evolution of these organs, considering the fact that the males of all orders of insects have more developed antennæ than the females, the latter being the more sluggish and living in more retired and concealed places, while the males have more active habits, sharper senses, and are more likely to find the females, and thus ensure the maintenance of the species.

ACTION OF ACIDS AND COLOR LIGHT ON MARINE INVERTEBRATES.—M. Yung has recently investigated the effects of alkaline or acid media on Cephalopoda, and with results pretty similar to those of M. Richet with crayfish. The animals are extremely sensitive to the action of mineral acids; where litmus hardly announces the presence of an acid, a young poulpe will immediately give signs of great pain. But more is required to prove fatal. With one cc. in two litres of water, sulphuric, nitric, or hydrochloric acid proved fatal (in from two to four and a half hours) to *Eledone moschata*; but not to oxalic acid. Sulphuric acid was the least toxical of the mineral acids. Of the much less energetic organic acids, tannic acid acts most rapidly. The alkalies range as follows in (decreasing) order of toxical power:—Ammonia, potash, soda, lime, baryta; the action of ammonia being extremely rapid. M. Yung, has also verified, in the main, for marine animals, the results of his former experiments on fresh-water animals, regarding the influence of colored light on animal development; finding violet and blue light stimulant, while red and green retards the growth; yellow comes nearest to white.—*English Mechanic.*

THE THORAX OF THE BLOW FLY.—An essay on this subject by Arthur Hammond, treats especially of the limits of the several segments of the connate thorax of the Diptera. The author enters fully into the history of the different opinions relative to the morphology of the thorax, and then considers the structure of the thorax in other insects. He calls attention to the fact that in the Lepidoptera and Hymenoptera, the development of the segment is proportioned to that of the wings, and shows that the same rule holds good in the Diptera, the metathorax being as obsolete as the

long appendage it carries. He then examines the evidence derived from a study of the muscular and nervous parts, and from the phenomena of development. The work is thoroughly well done, but of such a nature that it cannot be abstracted. The two plates evince excellent artistic skill.

THE SWIMMING-BLADDER OF FISHES.—In a recent note to the Paris Academy, Prof. Marangoni gives the results he has arrived at in a study of the swimming-bladder. He states, first, that it is the organ which regulates the migration of fishes, those fishes that are without it not migrating from bottoms of little depth, where they find tepid water; while fishes which have a bladder are such as live in deep, cold water, and migrate to deposit their ova in warmer water near the surface. Next, fishes do not rise like the Cartesian diver (in the well known experiment), and they have to counteract the influence of their swimming-bladder with their fins. If some small dead and living fishes be put in a vessel three-quarters full of water and the air be compressed or rarefied, one finds in the former case that the dead fish descend, while the living ones rise, head in advance, to the surface. Rarefying has the opposite effect. Fishes have reason to fear the passive influence due to hydrostatic pressure; when fished from a great depth, their bladder is often found to be ruptured. Thirdly, the swimming-bladder produces in fishes twofold instability, one of level, the other of position. A fish, having once adapted its bladder to live at a certain depth, may, through the slightest variation of pressure, be either forced downwards or upwards, and thus they are in unstable equilibrium as to level. As to position, the bladder being in the ventral region, the center of gravity is above the center of pressure, so that fishes are always threatened with inversion; and, indeed, they take the inverted position when dead or dying. This double instability forces fishes to a continual gymnastic movement, and doubtless helps to render them strong and agile. The most agile of terrestrial animals are also those which have least stability.

ZOOLOGICAL NOTES.—From his study of the mollusks of the Challenger expedition, the Rev. R. B. Watson concludes that there are shallow and deep water species, *i. e.*, that depth of water is an important condition of molluscan life; while temperature is a more important condition than depth, the two combined proving barriers to distribution. It appears that where barriers of depth and temperature do not check distribution, there seems, in ordinary circumstances, no limit to universality of distribution, and there are actually existing species whose distribution is cosmopolitan, no barriers having availed against their passage; and, finally, Mr. Watson finds no trace in such species of essential, lasting and progressive change. These views are not new, but interesting as confirmed by recent investigations over the larger part of the

ocean bottom.——Spallanzani's experiments on the regeneration of the head of gasteropods have been confirmed and extended by Carrière, whose experiments show that the eyes, tentacles and labial processes may be completely regenerated, but not the pharynx or the brain, the destruction or removal of which causes the death of the animal.——Bees, wasps, &c., have been found to possess a spur at the apex of the first pair of tibiæ, whose function it is to clean the tongue and perhaps the antennæ also.——An odoriferous apparatus has been discovered by Von Richenau in *Sphinx ligustris*, consisting of a bunch of colorless hair-like scales lying in a fold on each side of the first abdominal segment. According to a notice in the *Journal* of the Royal Microscopical Society, the organ could be extruded from the fold by pressure. The aperture has the form of a cylindrical tube, and here a strong musky scent was perceptible, which did not occur elsewhere. The scales are visible with the naked eye.——Girard's *La Phylloxera* is a little closely-printed brochure of 120 pages, giving a résumé of all that is known in France concerning this dreadful pest. It is accompanied by a map of France, showing the districts more or less infested.——Some points in the developmental history of the lamprey eel are briefly discussed by Dr. W. B. Scott, in *Zoologischer Anzeiger* (Nos. 63, 64). No. 66 of the same useful periodical contains a notice of a viviparous Chirodota (*C. vivipara* = *C. rotifera*).——In our last number Fabre's discovery of parthenogenesis in a wild bee, Halictus, was noticed; we now have to record the discovery claimed by J. A. Osborne, in *Nature* for Sept. 30, of parthenogenesis in a beetle, *Gastrophysa raphani*. Mr. Osborne possessed a living beetle reared from an unfertilized egg.——The embryology of the gar-pike (Lepidosteus) has recently been studied by Messrs. Balfour and Parker, of England, from eggs supplied by Mr. A. Agassiz. They find that the segmentation of the egg is complete as in the sturgeon, and that the nervous system is formed by a solid thickening of the exoderm, as in the bony fishes, and not by the closure of a groove, as in the sturgeon; while the general relation of the embryo to the yolk, and the general characters of the germinal layers are precisely like those in the bony fishes.

ANTHROPOLOGY.[1]

New Archæological Enterprises.—In addition to the successful institutions, both national and local, for the exploration of our American antiquities, two new enterprises have been set on foot with every promise of success, the Archæological Institute of America and the Lorillard Mission to the ruined cities of Central America. Of the former we have a full account in the first annual report of the executive committee, 1879–80, with a study of the houses of the American aborigines, by Lewis H. Morgan;

[1] Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

description of the ancient walls on Monte Leon, Italy, by W. J. Stillman; and archæological notes on Greek shores, by Joseph Thacher Clarke. The plans and scope of the Lorillard expedition are clearly set forth in two articles in the *North American Review* for July and August, to wit, Ruined Cities of Central America, by the editor, Mr. Allen Thorndike Rice; and The Ruins of Central America, by M. Desiré Charnay, who has the exploration in charge. We mention these two works together because they seem to represent the two sides or the two schools of American interpretation with reference to the earthworks of the Mississippi valley, and the ruins of Mexico and Central America. In the introduction of the Archæological Institute Report we read: "The Study of American archæology relates to the monuments of a race that never attained a high degree of civilization, and that has left no trustworthy records of continuous history." Again, we are informed that the committee are in accord with Mr. Morgan, and that they have taken steps to send an agent to Colorado and N. Mexico to observe the Pueblo life, as an introduction to the comprehensive study of Mexico and Yucatan. The fact that Mr. Bandelier is to be that agent is a sufficient guarantee not only of exhaustive work, but of the line of research to be prosecuted. In the Lorillard expedition we are to have "adequate conceptions of the stately edifices of monumental Mitla, or of Palenque, with its magnificent palace, its terraces and temples, its pyramids and sculptured ornaments." It is not the province of the editor to treat with partiality either of these views, but to let the authors speak for themselves.

The Central American undertaking is despatched under the joint auspices of the Government of the United States and of France. The expenses will be defrayed by Mr. Pierre Lorillard, of New York, the original promoter of the enterprise, and by the French Government. The expedition is under the direction of M. Désire Charnay, author of "Cités et Ruines Américaines" (Paris, 1863). It is thoroughly equipped and is provided not only with the means of photographing bas-reliefs and inscriptions, but of making careful casts by the process of M. Lotin de Laval. Copies of these casts will first be presented to the Smithsonian Institution and to the French Government. The collection in France will be named after Mr. Lorillard, and the French Minister has conceded to the *North American Review* the privilege of publishing the earliest accounts from M. Charnay. Mr. Rice in speaking of Uxmal, writes: "It is as yet impossible to determine, with any approach to certainty, the ends which its ruined edifices were designed to serve, but is at least highly probable that they were originally palaces, temples, council-halls and courts of justice; possibly some of them may have been monasteries or community houses, in which the ascetics of a religion analagous to that of Budha lived in common." Again, "These bas-reliefs would of them-

selves appear to be enough to confute the theory according to which Palenque, Uxmal, and the other sites of ruins in this portion of the American continent are only 'pueblos,' groups of 'communal houses,' such as still exist and are still inhabited in New Mexico." M. Le Plongeon copied many beautiful frescoes from the walls of these structures, among them a picture of a frail hut of poles with thatched roof, which he supposed to have been the residence of some of the lower class of people. M. Charnay, who does not scruple to call Bourbourg and Le Plongeon fools, will find it difficult to take good care of his own self-control in a land that has turned the heads of many smart people.

Reverting to Mr. Morgan's paper in the Report of the Archæological Institute, we find that he bases his interpretation of Mexican and Central American architecture upon a study of the communal system of all our aborigines. Commencing with the "long-house" of the Iroquois, the Mandan circular lodge, and the immense structures of the Columbia river tribes, he proceeds to New Mexico and Arizona, where we have in the pueblo the climax of this communal life, and to the works of the Sciota valley, where the earthworks stand for embankments on which to erect long-houses. The pueblos, the mound structures, and the great stone edifices of middle America were joint tenement houses, in the nature of fortresses, and the plan of life within the last named must be sought in the present pueblos, assisted by the light of tradition. At the epoch of the Spanish conquest they were occupied, and were deserted by the Indians to escape the rapacity of the Spanish military adventurers, by whom they were oppressed beyond endurance. Mr. Morgan carefully examines the Casa del Gobernador, and the "House of Nuns," Uxmal, in the light of his own theory. The remarks on the method of constructing vaulted ceilings over a solid core of masonry are exceedingly valuable (p. 66–69). At the close of the article he takes Professor Rau to task for endorsing the palace and city theory of Mr. Stephens, and introduces epithets which we regret to see one American anthropologist using with reference to another. The work of the Archæological Institute is carried on by means of the subscriptions of the members, the annual fee being ten dollars. Those of our readers desiring to correspond with the Institute must address Mr. Edward H. Greenleaf, Museum of Fine Arts, Boston, Mass.

We may be allowed to hint that the simultaneity and succession of the complex elements of civilization are not made out sufficiently to allow one to be dogmatical. It is within the range of possibility that the lines of simultaneity may resemble the isotherms rather than the parallels of latitude. In that case communism in living and a gentile system of kinship might coexist with a high or a low stage of something else, say the mechanic arts or the fabrication of implements. Again, the separation of a people

into the regulative and the operative class may begin lower down in Mr. Morgan's scale than we have thus far been aware of. If so, it is not impossible that the gentile system and communism may have been associated with as much caste as would divide the tribe into the governing and the governed? Far be it from us to detract from the merit of our greatest generalizer in sociology; but it cannot be denied that the argument for the mere communal function of the earthwork and the Central American ruins is based upon analogy only.

JAPANESE MYTHOLOGY.—We are indebted to Prof. E. S. Morse, for the following extract from the Tokio *Times*, of May 22, by J. W. McCarthy:

"In few countries in the world can the adventurous wight who wishes to peer into the future have his desire so easily gratified, and in so many different ways, as in Japan. While in western nations divination is merely a subject of research and speculation amongst scholars, or, at most, is found at intervals in rural districts, far from the busy haunts of men, startling the apostle of nineteenth century civilization with its twelfth century superstition, here in Japan it is a living force, exercising its influence on the trader, the farmer, pilgrim, and even on the course of love itself. Nor is it confined to the poor and lowly; members of the higher classes, and the wealthy, do not disdain to make use of the diviner—and he is equal to the task. For a *tempo* or even a *mon*, he will tell the poor maiden whether her love is faithful, or the coolie whether his pilgrimage will prosper; while for his noble patrons he can perform an elaborate ceremony, in some cases possessing even religious sanctions of the most solemn kind, for which he is quite ready to accept a hundred, five hundred, or even a thousand *yen*.

"On this subject, a passage, almost as applicable to Japan as to China, may be quoted here from Dr. Dennys's little work on the Folk-lore of China.

"'Divination is in China as popular as, and probably more respectable than, it was amongst the Israelites in the days of the witch of Endor, and it is not perhaps going too far to say that there is not a single means resorted to in the West, by way of lifting the impenetrable veil which hides the future from the curious of mankind, which is not known to and practiced by the Chinese. From "Pinking the Bible" to using the Planchette, from tossing for odd and even to invoking spirits to actually speak through crafty media, the whole range of western superstition in this regard is as familiar to the average Chinaman as to the most enthusiastic spiritualists at home. The coincidences of practice and belief are indeed so startling that many will doubtless see in them a sort of evidence either for their truthfulness, or for a common origin of evil.'

"It is not intended at present to describe more than one mode of divination; but it is the mode which is universal among the lower classes, and which can be seen at work every day in the temples of the more corrupt or poorer sects of Buddhists, in Tokio and elsewhere. The materials are very simple. A small rectangular or oblong box is filled with slips of bamboo, each about six inches in length, and having a number written on the end. These can be shaken out, one by one, through a hole in the end of the box; and, according to the number on the first stick, the diviner selects from a drawer in a cabinet, close at hand, a printed slip of paper containing the inquirer's fate. The boxes vary according to age and sex; but the number of boxes in the possession of one temple rarely exceeds sixteen, eight for the various ages, and two for the sexes, with corresponding drawers in the cabinet. The stock in trade being so small, and the divining priest generally holding some other occupation about the temple, he can afford to sell his wares cheaply. Yet on festival days he must receive a large sum. At the temple between Kawasaki and the sea, the writer has seen as many as two hundred persons draw the divining sticks—*Miku-ji wo hiku*, as it is called—in an hour, and all of them seemed to treat the ceremony with the utmost seriousness and solemnity, generally stepping out before drawing the stick, and elevating their hands in prayer to the idol.

"This form of divination seems to be connected with Buddhism, as we find it also used in joss-houses in China. The box and sticks are rarely found among the possessions of an itinerant fortune-teller, and even then he is regarded as an impostor, or a priest who has been discharged for misconduct from his temple. In China, it is said, street fortune-tellers frequently train birds to select these sticks, thus adding an amusing element to the ceremony.

"In conclusion, translations of a few slips of paper, thus selected, may not be uninteresting. It will be observed that the style is somewhat oracular, and the fates decline to descend from the general to the particular. But papers are frequently drawn in which traders are recommended what to invest in and what to avoid:

"'1. *To a man of twenty-eight years:*—At first evil, then good: wealth will be scattered and lost. Misfortune will come suddenly; and quarrels will take place with wife and brethren.

"'2. *To a woman of thirty-seven:*—During spring and summer, the fates are unfavorable; but in autumn and winter things will go well. The expectations of youth will not be realized in old age.

"'3. *To a youth of nineteen:*—This world and the things thereof pass rapidly away, and it is ill to change present occupation for a new one. Sickness, when it comes, will do so with a heavy hand.

"'4. *To a girl of sixteen:*—Disappointment at first, but early

marriage brings early wrinkles: and the countenance of the goddess of mercy will ever afterward be favorable.'

"On another occasion we may possibly describe other forms of divination."

BURIAL OF THE DEAD.—The third in the series of Introductions to the study of the North American Indians, issued by the Bureau of Ethnology of the Smithsonian Institution, is a study of mortuary customs by Dr. H. C. Yarrow, U. S. A. In the preface Major Powell defines the work of the Bureau and the value of a study of mortuary customs in order to comprehend the philosophy of the people among whom they are practiced. Dr. Yarrow, after quoting from a circular issued by him three years ago, containing a series of questions upon burial customs, proceeds to give a classified arrangement of burials, which we produce in full:

1. Inhumation in pits, graves, holes in the ground, mounds, cists, and caves.

2. Cremation, generally on the surface, occasionally beneath, the resulting ashes or the bones being placed in pits, in the ground, in boxes placed on scaffold or trees, in urns, or sometimes scattered.

3. Embalmment, or a process of mummifying, the remains being afterwards placed in the earth, in caves, mounds, or charnel-houses.

4. Aerial sepulture, the bodies being deposited on scaffolds or trees, in boxes or canoes, the two latter receptacles supported on scaffolds or posts, or on the ground.

5. Aquatic burial, beneath the water or in canoes, which were turned adrift.

This order is not observed in the volume, the sub-divisions of the subject occurring as follows: Inhumation; burials in cabins, wigwams, or houses, called "lodge-burial"; stonegraves, or cists; burial in mounds; cave burial; mummies; urn-burial; surface burial; cairn-burial; cremation; partial cremation, by which a clay mold is taken; burial above ground; box burial; tree and scaffold burial; partial scaffold burial, and ossuaries; superterrene and aerial burial in canoes; aquatic burials; living sepulchres (by which is meant exposure to birds and beasts of prey); and cannibalism. The volume of 114 pages is made up of quotations from published works and from the author's correspondence illustrative of the kinds of material which he is most anxious to gather for a large and exhaustive work on mortuary customs. Communications should be addressed to Dr. H. C. Yarrow, Bureau of Ethnology, Washington, D. C.

THE AMERICAN ANTIQUARIAN.—The editor of this journal has widened its scope somewhat by introducing papers on Oriental archæology. Number four concludes the volume and the second year. The contents are as follows:

The pictured caves of La Crosse valley, by Edward Brown.
The theogony of the Sioux, by Stephen R. Riggs.
Teutonic mythology, by Rasmus B. Anderson.
Human sacrifices in ancient times. Trans., by L. P. Gratacap.
Prehistoric relics of Lowndes county, Miss., by Albert C. Love.

In the oriental department we have notes from Selah Merrill, A. H. Sayce and O. D. Miller. The correspondence, editorial notes, archæological notes, linguistic notes, art and architecture, and exchanges are unusually full and valuable.

MOUND RELICS FROM ILLINOIS.—Dr. P. R. Hoy, of Racine, Wisconsin, sends us photographs of a cranium taken from one of a group of mounds near Albany, Illinois. The tumuli are on the summit of a high ridge overlooking the Mississippi river. The one from which the skull was exhumed is about eight feet high, and forty feet in circumference. The skeleton was in a sitting posture at the base of the mound, the soil about it being of a darker color than that of the ridge below. On the top of the cranium was an inverted dish, holding about as much as a good sized tea-cup, the depth being just half the diameter. The outside is covered with fine basket markings, and four shields cross-barred, two of them with a central ring, are embossed at equal distances on the outside.

ANTHROPOLOGICAL NEWS.—The "*Archiv für Antropologie* has introduced a department of abstracts from anthropological literature foreign to Germany. Dr. Emil Schmidt, of Essen, Rhenish Prussia, has charge of that portion relating to America. He is very anxious to receive copies of all publications relating to our special subject. The last number reviews the Peabody Museum, the Davenport Academy, the American Antiquarian, and the NATURALIST.

GEOLOGY AND PALÆONTOLOGY.

THE DEVONIAN INSECTS.—Mr. S. H. Scudder has recently published a memoir on the oldest known insects, those found in the Devonian of New Brunswick. The locality from which the specimens were obtained, is not far from the town of St. Johns, from shales very rich in vegetable remains, and was discovered by the late Prof. C. F. Hartt. Six species are described by Mr. Scudder, and as may be supposed, are of considerable interest. A stratigraphic section by Professor J. W. Dawson accompanies the memoir. Mr. Scudder's conclusions are as follows:

"It only remains to sum up the results of this re-examination of the devonian insects, and especially to discuss their relation to later or now existing types. This may best be done by a separate consideration of the following points:

"There is nothing in the structure of these earliest known insects to interfere with a former conclusion that the general type of wing structure has remained unaltered from the earliest times. Three

of these six insects (Gerephemera, Homothetus, Xenoneura) have been shown to possess a very peculiar neuration, dissimilar from both carboniferous and modern types. As will also be shown under the tenth head, the dissimilarity of structure of all the devonian insects is much greater than would be anticipated; yet all the features of neuration can be brought into perfect harmony with the system laid down by Heer.

"The earliest insects were hexapods, and as far as the record goes, preceded in time both arachnids and myriapods.

"They were all lower Heterometabola.

"They are all allied or belong to the Neuroptera, using the word in its widest sense.

"Nearly all are synthetic types of comparatively narrow range.

"Nearly all bear marks of affinity to the carboniferous Palæodictyoptera, either in the reticulated surface of the wing, its longitudinal neuration, or both.

"On the other hand they are often of more and not less complicated structure than most Palæodictyoptera.

"With the exception of the general statement under the fifth head they bear little special relation to carboniferous forms, having a distinct facies of their own.

"The devonian insects were of great size, had membranous wings and were probably aquatic in early life. The last statement is simply inferred from the fact that all the modern types most nearly allied to them are now aquatic.

"Some of the devonian insects are plainly precursors of existing forms, while others seem to have left no trace. The best examples of the former are Platephemera, an aberrant form of an existing family; and Homothetus which, while totally different in the combination of its characters from anything known among living or fossil insects, is the only palæozoic insect possessing that peculiar arrangements of veins found at the base of the wings in Odonata typified by the arculus, a structure previously known only as early as the Jurassic. Examples of the latter are Gerephemera, which has a multiplicity of simple parallel veins next the costal margin of the wing, such as no other insect ancient or modern is known to possess; and Xenoneura, were the relationship of the internomedian branches to each other and to the rest of the wing is altogether abnormal.

"If, too, the concentric ridges, formerly interpreted by me as possibly representing a stridulating organ, should eventually be proved an actual part of the wing, we should have here a structure which has never since been repeated even in any modified form.

"They show a remarkable variety of structure, indicating an abundance of insect life at that epoch.

"The devonian insects also differ remarkably from all other

known types, ancient or modern; and some of them appear to be even more complicated than their nearest living allies.

"We appear, therefore, to be no nearer the beginning of things in the devonian epoch than in the carboniferous, so far as either greater unity or simplicity of structure is concerned; and these earlier forms cannot be used to any better advantage than the carboniferous types in support of any special theory of the origin of insects.

"Finally, while there are some forms which, to some degree, bear out expectations based on the general derivative hypothesis of structural development, there are quite as many which are altogether unexpected, and cannot be explained by that theory without involving suppositions for which no facts can at present be adduced."

America's Coal Supply.—Mr. P. W. Sheafer, of Pottsville, writes as follows respecting the supply of coal of the United States, and the methods of mining it: The coal resources of Great Britain are all developed now, and in process of depletion; whilst in this country when our four hundred and seventy square miles of anthracite are exhausted, we have more than four hundred times that area, or 200,000 square miles of bituminous, from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for two hundred years. With an annual production of 50,000,000, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the bituminous supply would be reached in eight hundred years. What the annual consumption will be when this continent supports a teeming population of 400,000,000 souls, as will be the case some day, must be left to conjecture. But with half that population, as energetic, restless and inventive as our people in this stimulating climate have always been, under the hopes of success, such a country as this constantly holds out to tempt ambition and reward enterprise, it is a very moderate estimate, guided by the actual output already reached in Great Britain, to suppose that there will be ample use for one hundred million tons a year of bituminous coal for home consumption alone.

We have about three hundred and forty collieries, and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly four thousand collieries, and mines 132,000,000 tons, or 33,000 tons per colliery. The greater the yield per colliery the less the expense in mining. If we decrease the number of mines and increase their capacity not only to raise the coal, but to exhaust a constant current of foul air and dangerous gases, clouds of powder smoke and millions of gallons of water, we will reduce the cost of mining. Most of the anthracite mining in the United States is now done at a less depth than five hundred feet

vertical; but as the coal nearer the surface becomes exhausted, the mines must go deeper and become more expensive.—*Proceedings of the American Association for Advancement of Science, 1879.*

THE NORTHERN WASATCH FAUNA.—The following species have been received from Mr. Wortman from the beds of the Wind River group, subsequent to the publication of my last notice of his discoveries:[1] (1) *Esthonyx spatularius*, sp. nov. Represented by five molar and premolar, and two incisor or canine teeth, apparently belonging to one individual. These are about the size of those of *E. bisulcatus*, but present several differences of detail. Thus the basin of the heel of the last inferior molar is not obliquely cut off by a crest which extends forwards from the heel, but is surrounded by an elevated border, which rises into a cusp on the external side. The incisor-canine teeth are more robust than those of *E. bisulcatus*, one of them especially having a spoon-shaped crown, with the concave side divided by a longitudinal rib, on which the enamel is very thin. The enamel descends much further down on the external than the internal side of these teeth. The rodent-like tooth does not accompany the specimen. Length of base of last inferior molar, .009; width anteriorly, .005; length of crown of canine-incisor No. 1. .009; width of do. at base, .005; length of crown of second canine-incisor at base, .012; width of do., .006. (2) *Didymictis leptomylus;* represented by the posterior three inferior molars. These indicate a species of smaller size than the *D. protenus*, with the tubercular molar relatively narrower, and perhaps longer. The anterior part of the latter has the three cusps well defined and close together, and behind them is an oblique longitudinal cutting edge. The middle of the posterior margin rises into a tubercle. The anterior cusps of the tubercular sectorial are elevated; the heel has a strong external cutting edge and internal ledge. Length of tubercular sectorial, .009; width of do., .005; length of tubercular, .007; width of do. in front, .0035. (3) *Hyopsodus speirianus*, sp. nov. Founded on a portion of a mandibular ramus supporting the last three molars in perfect preservation. It is distinguished by its very small size, since it is considerably less than the *H. vicarius (H.? minusculus)*, and by the equality in size of the molars. The heel of the third molar is very small, and the two cones of the inner side of the crowns of all the molars are acute. The external crescents are very well defined; the anterior sending a horn round the anterior extremity of the crown. The posterior is connected with the corresponding internal tubercle by a median conic posterior tubercle. Length of true molar series, .008; length of second molar, .0026; width of do., .0022; length of last true molar, .0025; width of do., .0016. Depth of ramus at second molar, .0043. Dedicated to my friend, Mr. Francis Speir, of Princeton, N. J., who, in connection with

[1] NATURALIST, Oct. (Sept.), 1880, p. 745.

Messrs. Scott and Osborne, has made important additions to our knowledge of the Eocene *Vertebrata*.—*E. D. Cope.*

GEOLOGICAL NEWS.—Mr. Hébert has recently published in the *Comptes Rendus* an account of the geology of the British Channel.——The last number of the Palæontographica contains two important memoirs: Roëmer on a Carbonaceous chalk formation of the West Coast of Sumatra; and Branco on the development of the extinct *Cephalopoda*.——M. Filhol having finished his work on the extinct *Vertebrata* of San Gerand le Puy, is about to publish one on those discovered at Ronzon.——The Powell Survey has just published Capt. Dutton's report on the Central Plateaus of the Colorado drainage.

GEOGRAPHY AND TRAVELS.[1]

PROCEEDINGS OF THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION.—The British Association for the Advancement of Science, held its fiftieth meeting at Swansea from the 25th of August to the 1st of September. The President of the Geographical Section, Lieutenant General Sir J. H. Lefroy, F. R. S., in his opening address, spoke at length on the progress of discovery on our own continent.

In other regions geography was the pioneer of civilization and commerce. Here for the first time she had been outstripped, for the telegraph and the railway had tracked the forest or prairie, and traversed the mountains by paths before unknown to her.

Within living memory no traveler known to fame had crossed the American continent from East to West except Andrew Mackenzie in 1793. No traveler had reached the American Polar sea by land except the same illustrious explorer and Samuel Hearne.

The British Admiralty had not long before instructed Captain Vancouver to search on the coast of the Pacific for some near communication with a river flowing into or out of the Lake of the Woods.

In proceeding to notice the extensive explorations and surveys undertaken by the Government of the United States and of Canada, he alluded to the great aid afforded the former by the physical features of the region of their trigonometrical survey where sharp rocky peaks, bare of vegetation, rise to altitudes of 10,000 to 12,000 feet at convenient distances, in an atmosphere of singular purity; whilst in the British territory a vast region, wholly wanting in conspicuous points, is to be laid out in townships of uniform area. The law required that the eastern and western boundaries of every township be true astronomical meridians, and that the sphericity of the earth's figure be duly allowed for, so that the northern boundary must be less in measurement than the southern. All lines are required to be gone over twice

[1] Edited by ELLIS H. YARNALL, Philadelphia.

with chains of unequal length, and the land surveyors are checked by astronomical determinations. In carrying out this operation, which will be seen to be one of great nicety, five principal meridians have been vigorously determined, and in part traced—the 97th, 102d, 106th, 110th and 114th; and fourteen base lines connecting them have been measured and marked. One of these, on the parallel of 52° 10′, is one hundred and eigthy-three miles long. The sources of the Frazer river were first reached in February, 1875, and found in a semi-circular basin completely closed in by glaciers and high base peaks at an elevation of 5300 feet. The hardy discoverer, Mr. E. W. Jarvis, traveled in the course of that exploration nine hundred miles on snow shoes, much of it with the thermometer below the temperature of freezing mercury, and lived for the last three days, as he expresses it, "in the anticipation of a meal at the journey's end." We are still imperfectly acquainted with the region north of the parallel of 50° in British Columbia, where the Canadian engineers have long been searching for a practicable railway line from one or other of the three known passes of the Rocky mountains proper through the tremendous gorges of the Cascade mountains to the Pacific. These passes are, the Yellowhead at an elevation of 3645 feet, the Pine river at 2800 feet, and the Peace river said to be only 1650 feet above the sea. The Dominion Government has recently adopted a line from the Yellowhead pass to Burrard inlet, which may be made out on any good map by following the course of the Thompson and Frazer rivers.

Dr. Dawson has recently explored the Queen Charlotte islands. He regards them as a partially submerged mountain chain, a continuation northwestward of that of Vancouver's island, and of the Olympian mountains in Washington territory. An island one hundred and fifty-six miles long and fifty-six wide, enjoying a temperate climate, and covered with forests of timber of some value (chiefly *Abies menziesii*) is not likely to be left to nature much longer.

The Abbé Petitot has recently made some remarkable explorations in the Mackenzie river district, between the Great Slave lake and the Arctic sea. Starting sometimes from St. Joseph's mission station, near Fort Resolution on Great Slave lake; sometimes from St. Theresa on Great Bear lake; sometimes from Notre Dame de Bonne Espérance on the Mackenzie, points many hundreds of miles asunder, he has, on foot or in canoe, often accompanied only by Indians or Esquimaux, again and again traversed that desolate country in every direction. He has passed four winters and a summer on Great Bear lake and explored every part of it. He has navigated the Mackenzie ten times between Great Slave lake and Fort Good Hope, and eight times between the latter post and its mouth. We owe to his visits in 1870 the disentanglement of a confusion which existed between the mouth of the Peel river (R. Plumée), and those of the Mackenzie owing

to their uniting in one delta, the explanation of the so-called Esquimaux lake, which, as Richardson conjectured, has no existence, and the delineation of the course of three large rivers which fall into the Polar sea in that neighborhood, the "Anderson" discovered by Mr. Macfarlane in 1859, a river named by himself the Macfarlane, and another he has called the Roncière. Sir John Richardson was aware of the existence of the second of these, and erroneously supposed it to be the "Toothless Fish" river of the Hare Indians (Beg-hui-la on his map). M. Petitot has also traced and sketched in several lakes and chains of lakes, which supports his opinion that this region is partaking of that operation of elevation which extends to Hudson's bay. He found the wild granite basin of one of these lakes dried up and discovered in it, yawning and terrible, the huge funneled opening by which the waters had been drawn into one of the many subterranean channels which the Indians believe to exist here.

These geographical discoveries are but a small part of l'Abbé Petitot's services. His intimate knowledge of the languages of the Northern Indians has enabled him to rectify the names given by previous travelers, and to interpret those descriptive appellations of the natives which are often so full of significance. He has profoundly studied their ethnology and tribal relations, and he has added greatly to our knowledge of the geology of this region.

It is, however, much to be regretted that this excellent traveler was provided with no instruments except a pocket watch and a compass, which latter is a somewhat fallacious guide in a region where the declination varies between 35° and 58°. His method has been to work in the details brought within his personal knowledge or well attested by native information on the basis of Franklin's charts.

M. Petitot expresses his opinion that the district of Mackenzie river can never be colonized—a conclusion no one who has visited it will be disposed to dispute; but he omits to point out that the mouth of that river is about seven hundred miles nearer the post of Victoria, in British Columbia, than the mouth of the Lena is to Yokohama, and far more accessible. It needs no Nordenskiöld to show the way. Its upper waters, the Liard, Peace, Elk and Athabasca rivers, drain an enormous extent of fertile country not without coal or lignite and with petroleum in abundance. As the Canadian geological survey has not yet been extended so far, we are not fully acquainted with its mineral resources; but the speaker adds his testimony to that of more recent travelers as to the remarkable apparent fertility and the exceptional climate of the Peace river valley.

As regards the extent to which the soil is now permanently frozen round the North Pole, Sir Henry Lefroy states that Erman, on theoretical grounds, affirms that the ground at Yakutsk is frozen to a depth of six hundred and thirty feet. At fifty feet be-

low the surface it had a temperature of 28° 5 F. and was barely up to the freezing point at three hundred and eighty-two feet. It is very different on the American continent. The rare opportunity was afforded me by a landslip on a large scale in May, 1844, of observing its entire thickness near Fort Norman, on the Mackenzie river, about two hundred miles further north than Yakutsk, and it was only forty-five feet. At York factory and Hudson's bay it is said to be about twenty-three feet. The recent extension of settlements in Manitoba has led to wells being sunk in many directions, establishing the fact that the permanently frozen stratum does not extend so far as that region, notwithstanding an opinion to the contrary of the late Sir George Simpson. Probably it does not cross Churchill river, for Sir H. Lefroy was assured that there is none at Lake à la Crosse. It depends in some measure on exposure.

In the neighborhood of high river banks, radiating their heat in two directions, and in situations not reached by the sun, the frost runs much deeper than in the open. The question, however, to which Sir John Richardson called attention so long ago as 1839, is well deserving of systematic inquiry, and may even throw some light on the profoundly interesting subject of a geographical change in the position of the earth's axis of rotation.

The Saskatchawan is now navigated from the Grand Rapids, near Lake Winnipeg to the base of the Rocky mountains. The impediments to navigation on the Nelson river have been found to be insuperable, and a company has been formed to make a railway from the lowest navigable point to the mouth of the Churchhill river.

The land around Hudson's bay is rising at the rate of five to ten feet in a century, The mouth of the Churchill affords far superior natural advantages for shipping the agricultural products of the Northwest territory than York Factory.

MICROSCOPY.[1]

THE NATIONAL SOCIETIES.—The American Society of Microscopists, held its third annual meeting at Detroit, on the 17th to 19th, of August last, under the presidency of Prof. H. L. Smith, of Geneva, New York. Regular morning and afternoon sessions were held during the three days; and, in all, fourteen papers were read, eight on microscopy proper, and six on natural history subjects connected with the use of the microscope. Included in the latter number is the very elaborate and interesting President's Address, delivered by Prof. Smith, on the subject of Deep Sea Life. A soirée was held in a public hall one evening, which was well attended, and was as fully calculated to accomplish its object of public entertainment and popular instruction in the powers and application of the microscope, as could reasonably be expected

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

under the disadvantage of very limited time and opportunities for preparation. No executive business of very general interest and radical importance was transacted, except, perhaps, the adoption of a rule prohibiting the publication elsewhere of papers read before the Society in advance of their appearance in the official proceedings; an experiment which is not likely to be successful, as its operation, if persisted in, will, according to the experience of other organizations, greatly limit the activity of the Society itself without materially increasing the importance attached to its printed proceedings. Mr. J. D. Hyatt, of New York, was elected president, and the time and place of holding the next annual meeting were left to the selection of the executive committee.

The American Association for the Advancement of Science met in Boston on the following Wednesday, August 25th, and continued in session for eight days. It is safe to say that no such meeting of scientists has ever been held in this country before, or is likely to be soon held again. A thousand members were in attendance, including names notable in every branch of science; two hundred and eighty papers were presented, extending over a wide range of subjects, and many of them of universal interest; while the thoughtful and lavish hospitality of the citizens of Boston and vicinity rendered the week of the meetings an ovation, from beginning to end. Of such a vast enterprise, the subsection of microscopy would necessarily be a small though not unimportant fraction. Under the chairmanship of Prof. S. A. Lattimore, of Rochester, and with the able assistance of the Boston Microscopical Society, the best of arrangements were made, and formal meetings were held on three different days, at which meetings fourteen papers were read, eight upon microscopy proper, and six upon natural history subjects connected with the use of the microscope. In addition to these, many valuable microscopical papers were read at various times, in other sections, in connection with botany, entomology, etc., to say nothing of unlimited opportunities of intercourse with persons distinguished in related branches of science, of hearing papers and discussions on other subjects, and of enjoying the general privileges of a memorable week. Much field work was done by various members, on the seashore and elsewhere. A soirée was given at the usual rooms of meeting, during one evening, but no attempt was made to render it a popular exhibition. Rev. A. B. Hervey, of Taunton, Massachusetts, was elected chairman for the next meeting, which will be held at Cincinnati.

Probably no thoughtful person who attended both meetings this summer, the American Society of Microscopists at Detroit, and the subsection of microscopy, A. A. A. S., at Boston, failed to notice the nearly equal division of strength between the two conventions. The personal attendance at the meetings was about equal, though mainly of different individuals; the number of papers read was

precisely the same, and it is only fair to say that in interest and importance they were very evenly divided. It is obvious that if the strength of the two meetings could have been combined in one, the result would have been far more adequate and satisfactory. This reflection has derived force from the well known fact that in the Microscopical Congress at Indianapolis, nearly half the voices were in favor of joining with the A. A. A. S., instead of forming a separate society, the latter course being adopted in the critical vote by a majority of one. From first to last, it has been of great and conceded importance to combine all our strength in one enterprise; but the obstacles which originally rendered this impossible, still remain, and it is evident that indiscreet controversy might increase and perpetuate the difficulties it was designed to remove. It would be absurd to ask persons accustomed to attend the meetings of the great society, and highly valuing its opportunities for intercourse with a large number of leading minds in various departments of science, to abandon that for any narrow organization, however attractive might be its field. On the other hand the new society could not profitably be united with the old, as has been proposed, without a more cordial and general support of such a procedure than could at present be hoped for. The subordination to greater interests, which would be encountered in uniting with the great society, would be more than counterbalanced, in many minds, by the social and scientific advantages gained; and the fact that many of the papers read would be excluded from the Proceedings by a necessity which admits only contributions new to science, would be of little consequence, since popular papers gain an earlier and a wider distribution through the popular journals; but a more serious difficulty arises from the localities in which the meetings of the A. A. A. S., are sometimes held. The large and powerful society can afford to appoint meetings, not unfrequently, for the sake of cultivating local interest in science, in localities which would be unavailable for the microscopical meetings. A joint meeting at Boston would have given a large increase of vitality; the same will not be equally true of all other localities.

If for these or any other reasons, it should be impracticable to combine the two societies at present, the greatest advantages would doubtless be secured by such a policy as would show, on both sides of the question, a reasonable and considerate regard for the interests of the other. The very large minority at Indianapolis acquiesced in the formation of a new society with the understanding that the times and places of meeting were to be so chosen as to best accommodate those who might wish to attend both. This policy, if fully carried out, would not prevent meeting at the same place when expedient, and would not require it when some other correlated place would be advisable. It would give many of the advantages of union, with entire freedom from its

difficulties. It is the least that could in reason be asked, or that could in common courtesy be granted as a means of securing a cordial and harmonious support for the new society.

NEW LOCAL SOCIETIES.—The Central New York Microscopical Club was organized some months since, at Syracuse, New York.

The Lancaster, Pennsylvania, Microscopical Society, J. W. Crumbaugh, M. D., president, was organized February 9th.

The Elmira Microscopical Society was organized May 13th, with S. O. Gleason, M. D., for president, and D. R. Ford, Ph.D., vice-president, and T. J. Up de Graff, M. D., secretary and treasurer.

The Fort Wayne Microscopical Society held its first meeting, September 18th, with F. W. Kuhne, president, C. A. Dryer, M.D., and C. W. McCaskey, M. D.; vice-presidents, C. L. Olds and L. R. Hartman, secretaries, and Paul Kuhn, treasurer.

The Microscopical Society of Central Illinois was organized at Springfield, Illinois, September 23d, F. L. Matthews, M. D., being the first president, and T. B. Jennings, secretary.

The Reading, Pennsylvania, Society of Natural Sciences, which has been in existence for over ten years, held a series of microscopical meetings, of the soirée order, last winter, which were quite successful, and which will probably be continued.

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SCIENTIFIC NEWS.

— At the late meeting of the American Association at Boston, Prof. A. Hyatt gave a popular lecture on the transformation of Planorbis as a practical illustration of the evolution of species. The lecture was illustrated with stereopticon views. After the lecture Mr. Carl Seiler threw some microscopical illustrations upon the screen. Prof. Hyatt spoke substantially as follows: The word evolution means the birth or derivation of one or more things or beings from others, through the action of natural laws. A child is evolved from its parents, a mineral from its constituents, a state of civilization from the conditions and surroundings of a preceding age. While evolution furnishes us with a valuable working hypothesis, science cannot forget that it is still on trial. The impatience of many when it is doubted or denied, savors more of the dogmatism of belief than of the judicial earnestness of investigation. Every individual differs in certain superficial characters from the parent forms, but is still identical with them in all its fundamental characteristics. This constantly recurring relationship among all creatures is the best established of all the laws of biology. It is the so-called law of heredity, that like tends to reproduce like. There seems to be only two causes which produce the variations which we observe; one is the law of heredity, the other is the surrounding influences or the sum of

the physical influences upon the organism. The first tends to preserve uniformity, the second modifies the action of the first. The law of natural selection asserts that some individuals are stronger and better fitted to compete with others in the struggle of life, than are others of the same species; hence they will live and perpetuate their kind, while the others die out. An erroneous impression exists that Darwinian doctrines are more or less supported by all naturalists who accept evolution, but it is far from the truth. The Darwinian hypothesis is so very easy of application, and saves so much trouble in the way of investigation, that it is very generally employed without the preliminary caution of a rigid analysis of the facts, and it is safe to say that it is often misapplied. A great amount of nonsense has been written about its being a fundamental law, in all forgetfulness that we are yet to find a law for the origin of the variations upon which it acts; it cannot be the primary cause of the variations, for the laws of heredity are still more fundamental. The speaker then described the situation and character of Steinheim, where numerous shells of the Planorbidæ are found in the strata, which have been very regularly deposited. Hilgendorf claims to have discovered great evidences of the gradual evolution of the various forms from the simplest and oldest specimens, but Mr. Hyatt has failed to find what Hilgendorf describes. By means of a lantern a number of illustrations of the shells were projected upon a screen and quite fully described. Four lines of descendants were shown to branch out from four of the simplest forms, with all the gaps between the species filled with intermediate varieties. Each one of the lines or series has its own set of characteristic differences, and its own peculiar history. It is a fair inference from the facts before us, that the species of the progressive series, which become larger and finer in every way, owe their increase in size to the favorable physical condition of the Steinheim basin. Darwinists would say that in the basin a battle had taken place, which only the favored ones survived. Mr. Hyatt endeavored to present, in a popular manner, the life-history of a single species, the *Planorba lævis*, and its evolution into twenty or thirty distinguishable forms, most of which may properly be called by different names and considered as distinct species. He also endeavored to bring the conception that the variations which led to these different species were due to the action of the laws of heredity, modified by physical forces, especially by the force of gravitation, into a tangible form. There are many characteristics which are due solely to the action of the physical influences which surround them; they vary with every change of locality, but remain quite constant and uniform within each.

— Dr. E. L. Trouessart communicates a valuable essay in defence of the doctrine of derivation to No. 16 (October) of the *Revue Scientifique*. He states the position of the objectors to

this doctrine to consist in the assertions, that (1) no palæontologist has shown the transition of one species into another; and (2) that the geological record should furnish the history of such changes had they taken place. To this the author of the paper replies (1) that many intermediate forms connecting widely separated living types have been discovered by palæontologists. (2) That the geological record is too imperfect to furnish all the transitions that the theory of derivation requires. (3) That observation of actual transition is not necessary in evidence, since there is reason to believe that transformations have proceeded more rapidly under some circumstances than others, and through changes transpiring during embryonic life. In support of the latter hypothesis, he cites the writings of Dall (1877) and Selys Longchamps (1879) on *Saltatory Evolution.*

— An interesting discovery has been made at Edge Lane quarry, Oldham, England. The quarrymen, in the course of their excavations, have come upon what has been described as a fossil forest. The trees number about twelve, and some of them are two feet in diameter. They are in good preservation. The roots can be seen interlacing the rock, and the fronds of the ferns are to be found imprinted on every piece of stone. The discovery has excited much interest in geological circles round Manchester, and the "forest" has been visited by a large number of persons. The trees belong to the middle coal measure period, although it has been regarded as somewhat remarkable that no coal has been discovered near them. The coal is found about two hundred and fifty yards beneath. Prof. Boyd-Dawkins, of Owens College, has visited the quarry.—*London Times.*

— Dr. Asa Gray left London for Paris last month, and is probably now botanizing in Spain.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History, Oct. 6.—Mr. S. H. Scudder gave an account of the geology and palæontology of the Lake basin of Florissant, Colorado, famous for its insect and plant remains.

Oct. 20.—Mr. J. A. Allen spoke of the distribution of the birds of the West Indies, with special reference to those of the Caribbee islands. The President showed specimens of the carboniferous centipede, Euphoberia, some of gigantic size, and discussed their relationship to living and extinct types. Dr. W. F. Whitney described the structure of the so-called "sucking stomach" of Butterflies.

Nov. 3.—Prof. E. S. Morse spoke on the Ainos of Yesso, showing some of their implements, etc.; Mr. Scudder exhibited an in-

teresting carboniferous fossil from Illinois; Mr. Hyatt described the molting of the lobster; while Mr. Putnam showed a remarkable piece of pottery from an Arkansas mound, and referred to the supposed resemblances between the pottery from these mounds and from Peru.

NEW YORK ACADEMY OF SCIENCES, Oct. 11.—Mr. A. A. Julien gave the results of recent observations on mountain-sculpture in the Catskills.

Oct. 18.—Prof. Newberry described the great deposits of crystalline iron ore in Southern Utah; and Prof. Martin exhibited and read notes upon specimens of the fossil leaves contained in the tufa of Brazil.

Oct. 25.—Prof. T. Egleston read a paper on American processes for the manufacture of copper.

APPALACHIAN MOUNTAIN CLUB, Boston, Oct. 13.—Prof. G. Lanza gave an account of a sojourn in Andover, Maine. Mrs. L. D. Pychowska described Bald hill, Campton, N. H. Carter dome, Huntington ravine and the Montalban ridge were described by Mr. W. H. Pickering; and Prof. C. E. Fay remarked upon a peculiar feature of Mt. Lincoln, Franconia mountains, N. H.

MIDDLESEX SCIENTIFIC FIELD CLUB, Oct. 13.—The Club held its first regular meeting since its adjournment for the summer months. L. L. Dame read a paper on the "Preservation of our Native Plants." The reading was followed by discussions.

Nov. 3.—The President, Henry L. Moody, read a paper on "Mimicry of Insects." The Club adopted measures looking to the establishment of a museum to illustrate the Natural History of Middlesex county.

AMERICAN PHILOSOPHICAL SOCIETY, Philadelphia, March 19.—A communication was received, entitled "Nodal estimate of the Velocity of Light, by P. E. Chase." Mr. Phillips read a paper describing two very old and curious maps of North and South America. Dr. Greene communicated a paper "On the action of hydrochloric acid and of chlorine on acetobenzoic anhydride."

April 2.—A paper was read, entitled "On the Origin of Planets," by Daniel Kirkwood.

April 16.—Mr. Hall described casts from the State Geological Museum.

May 7.—Mr. Robinson read a biographical memoir of the late M. Michel Chevalier. A paper entitled "Second Contribution to the History of the *Vertebrata* of the Permian formation of Texas, by E. D. Cope," was presented.

May 21.—Mr. Phillips presented a paper on "Some recent discoveries of Stone Implements in Africa and Asia." Prof. Cope remarked on the Lower Tertiary formations.

June 18.—Mr. Blodgett made some observations on "Certain features of industrial migrations."

July 16.—Prof. Cope presented a paper "On the Genera of the *Creodonta*."

Aug. 20.—Two papers were presented, entitled "Notes respecting a re-eroded channel-way" and "Notes on some features of the Geology of Scott and Wise counties, Va.," by J. J. Stevenson.

Sept. 17.—Mr. H. G. Jones presented a paper entitled "Notes on the Cumberland or Potomac Coal basin." Mr. Lesley proposed another Egyptian etymology in Greek, viz, the name of the Eleusinian Sun God, *Ιαχχος* from aχu in the Sphinx name of the Nilotic morning sun god Horus:—Hor-m-aχu, The sun on the horizon.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE—October. Larval Forms: their nature, origin and affinities, by F. M. Balfour. (An attempt to study the relations of the larvæ of Echinoderms, mollusks and worms, and to determine the characters of the common prototype, Pilidium coming nearest to this form in the course of its conversion into a bilateral form; the Trochosphere being a completely differentiated bilateral form in which an anus has become developed. The bilateral symmetry of the larva of Echinoderms is supposed to be secondary, like that of many Cœlenterate larvæ.) The Eye of Pecten, by S. J. Hickson. (Its anatomy is exceedingly complicated, and exhibits all the most important structural elements of the eyes of the higher Vertebrata, but the mode of formation of the molluscan eye is essentially different from that of the Vertebrata, and the resemblance in the adult is merely accidental, not homological. The Pecten is probably capable of appreciating very diffused light, for the close approximation of the lens to the retina makes it exceedingly improbable that any image is formed upon the latter; so that its visual power would not enable it to avoid its enemies.) On the terminations of nerves in the epidermis, by L. Ranvier. On the termination of the nerves in the mammalian cornea, by E. Klein.

ANNALES DES SCIENCES NATURELLES, August. On the Metamorphoses of Bryozoa, by J. Barrois. Researches in the fauna of southern regions, by A. Milne-Edwards (based on the geographical distribution of the penguins, with a map and plate).

ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE—Sept. 10. The anatomy of *Distomum hepaticum*, by F. Sommer (richly illustrated). Description of the nervous system of *Oryctes nasicornis* in the larva, pupa and beetle stages, by H. Michels (elsewhere noticed).

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT—October 5. On the direction of the pollen tubes in the Angiosperms, by M. Dalmer. On the gill-bearing Tritons, by O. Hamann.

AMERICAN JOURNAL OF SCIENCE AND ARTS—November. Remarkable marine Fauna occupying the outer banks off the southern coast of new England, by A. E. Verrill. Revision of the land snails of the Paleozoic era, with descriptions of new species, by J. W. Dawson. Extension of the Carboniferous Formation in Massachusetts, by W. O. Crosby and G. H. Barton.

PSYCHE, Cambridge—July. Chemical change of coloration in Butterfly's wings, by W. H. Edwards and J. M. Wilson.

August.—The Trophi and their chitinous supports in Gracillaria, by G. Dimmock. With the usual bibliographical record, so valuable a feature of this journal.

GEOLOGICAL MAGAZINE—October. Volcanic Eruption and Earthquakes in Iceland within historic times, by T. Thoroddsen.

THE FIFTEENTH VOLUME OF THE AMERICAN NATURALIST.—We would call the attention of our subscribers to the fact that the present volume contains 926 pages, or 120 more than the preceding volume.

We shall continue the coming year the reviews of progress in different departments of natural science, and from the papers in hand and those promised can give the assurance that Volume XV, will, at least, not be inferior in variety and interest to its predecessors.

As during the past fourteen years, we continue to invite the contributions of original notes and articles, and items of scientific news, and ask our friends to call the attention of those in any way interested in natural history to our magazine, as an aid and stimulus in their reading and observations in the field. The larger our subscription list, the more matter and illustrations can we offer to our patrons.

We have pleasure in announcing the purchase of the subscription list and good will of the "American Entomologist," which will in future be represented by a new department of the NATURALIST, to be devoted exclusively to Entomology. It will be conducted by the distinguished scientist, Dr. C. V. Riley, whose accession to our editorial corps, we think, constitutes an important era in the history of the AMERICAN NATURALIST.

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ERRATA.—On page 64, for Ogoowé read Ogowé; page 144, for Naverbine read Nambwe.

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